Aviation Week
and Space Technology

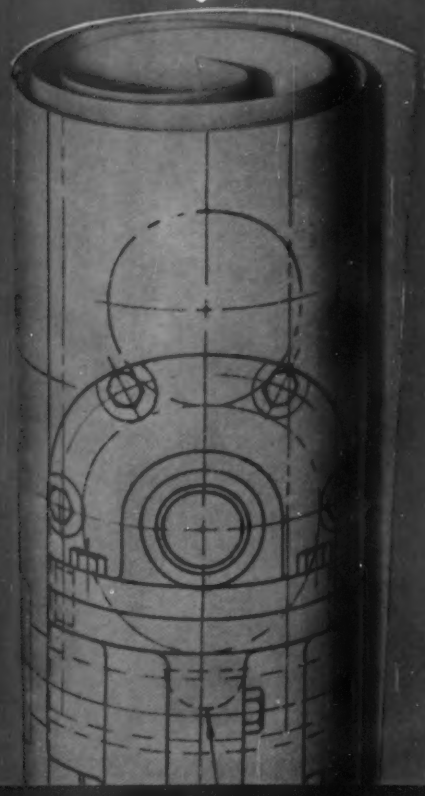
October 24, 1960

Optical Masers Transmit Light For Space Uses

Grumman A2F-1 Intruder

LONG-LOK *self-locking device*

a planned solution to Lock and Anchor fastening problems



Voi-Shan's Long-Lok is a proof-tested, self-locking device designed to resist vibration. This insert can be incorporated into any male-threaded part for use in any medium at temperature ranges from −370°F to +1200°F. Qualified to performance requirements of applicable military specifications, Long-Lok is economical—eliminates the need for lock-washers, safety wires and adhesive staking compounds. It is another example of Voi-Shan's reliable engineering skills. A letter on your company letterhead brings Voi-Shan's technical brochure without charge. Include your application requirements for a specific reply.

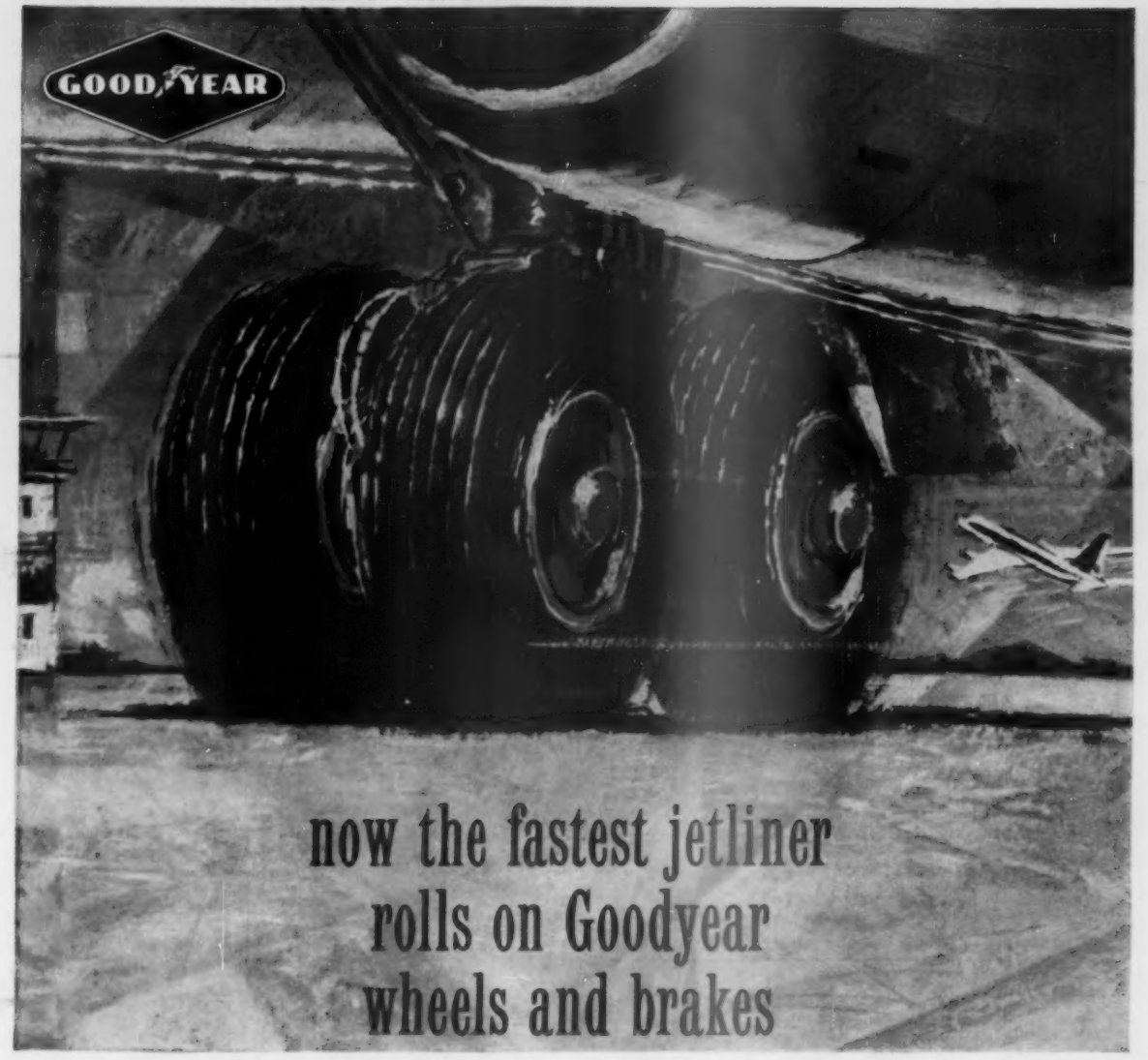
VSI

VOI-SHAN MANUFACTURING CO.

A Division of Voi-Shan Industries, Inc.

8463 HIGUERA STREET, CULVER CITY, CALIFORNIA

GOODYEAR PRESENTS CREDENTIALS FOR ANOTHER CAPABILITY



now the fastest jetliner rolls on Goodyear wheels and brakes

Convair's sleek 880, the nation's fastest jetliner, designed for medium-range service—makes more landings, take-offs and taxi runs than long-range planes. Mighty rough duty for its wheels and brakes.

That's why we're proud to report that Goodyear wheels and brakes are used by Convair Division of General Dynamics Corporation on 880's in service and going into service on Delta Air Lines. They're built to stand up under the most punishing loads. For instance, at take-off an 880 may tip the scales at almost ninety tons!

Picking this Goodyear team is virtually a tradition in the aircraft industry. For the past 20 years more commercial airliners have been equipped with Goodyear wheels and brakes than with all other makes combined. Here's a brief sampling of *new* aircraft relying on their high reliability and low operating cost:

Commercial—Convair 880 · Fairchild F-27

Navy—A2F attack bomber · W2F early-warning plane · HU2K helicopter

Air Force—B-58 Supersonic bomber · F-105D fighter-bomber · T-39 trainer

Army—Grumman OA-1 · Vertol YHC-1B helicopter

Executive—Grumman Gulfstream · Beechcraft Queen Air

Light—Aero Commander Model 680F · Cessna Model 210

Need wheels offering the longest roll-life and the best load/weight ratio—need lightweight, reliable brakes? They're yours in Goodyear's famous Aluminum or Magnesium Wheels and Tri-Metallic Brakes. Write on company letterhead for details to:

The Goodyear Tire & Rubber Company,
Aviation Products Division,
Dept. V-1715, Akron 16, Ohio.

Lots of good things come from

GOODYEAR AVIATION PRODUCTS

More aircraft land on Goodyear tires, wheels and brakes than on any other kind

a message to men who are pioneering the future . . . Ponder for a moment the imagination behind Clayley's VERTOL craft of 1842, then marvel at where the Industry might be had this pioneer had today's production resources! ■ Because Ex-Cell-O is in business to help relieve you of many development and manufacturing details that can hamper your creativity, in this condensed list of capabilities you may find a means of getting your project off the ground sooner than scheduled: ■ Fuel controls and injection systems; linear and rotary actuators for GSE and airborne applications; air bearing devices; inertial guidance systems; servomechanisms; data processing memory drums; nuclear powerplant components; hardened and ground precision production parts. ■ Our Representative nearest you will gladly elaborate on Ex-Cell-O's products and services.

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN 60-12
Aircraft & Missile Division

Artist's conception of Sir George Clayley's mid-19th Century helicopter shows contra-rotating multiple rotors and pusher props. Design lacked a practical engine and power train.

MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O AND ITS SUBSIDIARIES: BRYANT CHUCKING GRINDER CO., CADILLAC GAGE CO., MICHIGAN TOOL CO., SMITH BEARING CO. ■ EX-CELL-O FOR PRECISION XLO

AVIATION CALENDAR

Nov. 1-2—Fall Meeting, Radio Technical Commission for Aeronautics, Sheraton-Park Hotel, Washington, D. C.

Nov. 2-4—Tenth Aircraft Hydraulics Conference, Pick-Fort Shelby Hotel, Detroit, Mich., Sponsor: Vickers, Inc., division of Sperry Rand Corp. (Invitational.)

Nov. 3-4—Annual Fall Meeting, Northeast Chapter-American Assn. of Airport Executives, Sheraton Inn, Binghamton, N. Y.

Nov. 14-15—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Olympic Hotel, Seattle, Wash.

Nov. 14-16—National Convention, National Aeronautics Assn., Indio, Calif.

Nov. 14-17—Sixth Annual Conference on Magnetism and Magnetic Materials, New Yorker Hotel, New York, N. Y.

Nov. 14-18—Flight Safety Foundation's 13th Annual International Air Safety Seminar, in cooperation with Aviation Crash Injury Research, Phoenix, Ariz.

Nov. 14-18—Western Engineering Conference and Exhibit, American Society of Tool and Manufacturing Engineers, Memorial Sports Arena, Los Angeles, Calif.

Nov. 14-19—Annual Convention, Air Line Pilots Assn., Carillon Hotel, Miami Beach, Fla.

Nov. 15-16—Symposium on Engineering Application of Probability and Random Function Theory, Purdue University, Lafayette, Ind.

Nov. 15-16—12th Annual Mid-America Electronics Conference, Institute of Radio Engineers, Hotel Muehlebach, Kansas City, Mo.

Nov. 15-17—36th Meeting, Aviation Distributors and Manufacturers Assn., Riviera Hotel, Palm Springs, Calif.

Nov. 15-17—Air Force-Navy-Industry Pro-

(*Continued on page 6*)

AVIATION WEEK and Space Technology

October 24, 1960

Vol. 73, No. 17

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It has taken insects thousands of years to evolve countless variations of antennas to suit environmental conditions and adapt them to perform specific functions perfectly. Dorne & Margolin engineers have less time at their disposal, yet they achieve similarly satisfactory end results.

And the insect world has nothing on Dorne & Margolin when it comes to all-out organization to get the job done. Meticulous as bees, determined as ants, more curious than moths . . . that's the approach to every problem in components or systems . . . aircraft or missiles, practiced by D & M engineers.

The results have been products in which we can confidently take pride . . . just ask our customers*. By the way, our engineers still have a healthy and creative curiousity about antenna problems. If there's one plaguing you, no matter how large . . . or small, drop us a line.

*A customer list is included in our Antenna Catalog. Write for your copy today.

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If you're an engineer whose creative curiousity is matched by a desire for many organizational benefits, including stock participation, contact R. E. Anderson, Chief Engineer.

This is the SWAMI MOTION DETECTOR, a compact practical detection device for Perimeter Protection, Plant and Area Security.

NEW "POCKET RADAR"

Sensitive, dependable, inexpensive, unitized construction (it's small enough to fit into an attache case). *Where can you use it?*

The SWAMI MOTION DETECTOR is a new low-cost intrusion detector system that saturates a secured area with ultra high radio frequency energy sensitive to the slightest motion or displacement of an intruder. It is fail safe, simple to install, easily operated. And, it is virtually impossible to confound with counter-measures: any tampering will cause an alarm.

Effective Range: From inches to hundreds of feet, with a single unit. Surveillance can be maintained over a full acre, economically.

Flexibility: It can function as an omnidirectional or directional system, and can determine relative or absolute speeds of moving targets.

Durability: The sensor unit of the SWAMI MOTION DETECTOR is shock-resistant, and its service life compares favorably with that of conventional vacuum-tube detection devices.

Power Supply: Standard 115-volt outlet current or any battery-supply DC. *Write for free brochure to:*

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AVIATION CALENDAR

(*Continued from page 5*)

pulsion Systems Lubricants Conference (unclassified), Hilton Hotel, San Antonio, Tex.

Nov. 15-18—Annual Meeting, Executive Board of the Flight Engineers International Assn. (AFL-CIO), Sheraton-Atlantic Hotel, New York, N. Y.

Dec. 5-8—15th Annual Meeting and Astronautical Exposition, American Rocket Society, Shoreham Hotel, Washington, D. C.

Dec. 6-8—Annual Meeting, National Aviation Trades Assn., Oklahoma-Biltmore, Oklahoma City, Okla.

Dec. 12-15—Atomic Industry Exhibition, California Masonic Memorial Temple, San Francisco, Calif., concurrent with the Atomic Industrial Forum's Annual Conference (Fairmont Hotel) and the American Nuclear Society's Winter Meeting (Hotel Mark Hopkins).

Dec. 13-15—Tenth Annual Eastern Joint Computer Conference, Hotel New Yorker and Manhattan Center, New York, N. Y. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; Assn. for Computing Machinery.

Dec. 17—24th Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C.

Dec. 26-31—127th Meeting, American Association for the Advancement of Science, New York, N. Y.

Dec. 28-30—Seventh King Orange International Model Plane Meet, Miami, Fla.

Jan. 9-11—Seventh National Symposium on Reliability and Quality Control, Bellevue-Stratford Hotel, Philadelphia, Pa.

Jan. 9-13—International Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit, Mich.

Jan. 16-18—Seventh Annual National Meeting, American Astronautical Society, Dallas, Tex.

Jan. 23-25—29th Annual Meeting, Institute of the Aeronautical Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 24.

Feb. 1-3—Second Winter Military Electronics Convention, Institute of Radio Engineers, Biltmore Hotel, Los Angeles.

Feb. 1-3—Solid Propellants Conference, American Rocket Society, Salt Lake City, Utah.

Feb. 15-17—International Solid-State Circuits Conference, Institute of Radio Engineers, University of Pennsylvania campus and Sheraton Hotel, Philadelphia.

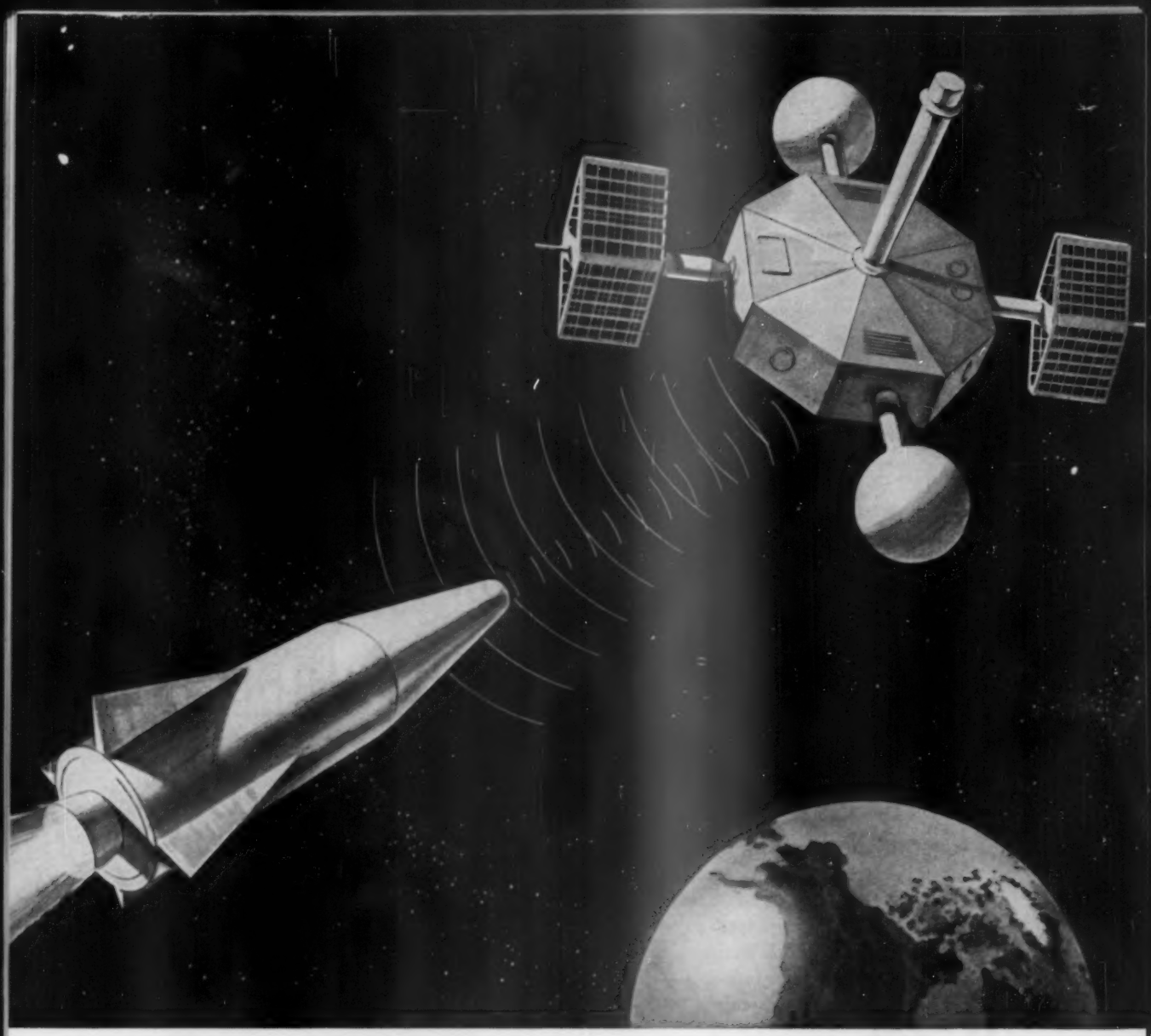
Mar. 5-9—Sixth Annual Gas Turbine Conference and Exhibit, American Society of Mechanical Engineers, Shoreham Hotel, Washington, D. C.

Mar. 9-10—Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia, Pa.

Mar. 13-16—Test, Operations and Support Conference, American Rocket Society, Biltmore Hotel, Los Angeles, Calif.

Mar. 16-18—Fifth National Conference on Aviation Education, Mayflower Hotel, Washington, D. C.

Mar. 20-23—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.



For Space Applications, Raytheon offers proven, off-the-shelf techniques in CW Radar

Raytheon has been investigating, developing and producing Continuous Wave Radars for more than ten years. Impetus for the program was the anticipated problems of clutter rejection, ever-increasing intercept velocities, and low weight-high reliability requirements in the aero-space era.

This pioneering effort has resulted in several dramatic achievements: multi-kilowatt, low noise transmitters; unique antennas that transmit and receive simultaneously; a feed-through nulling device that adds isolation to the antenna; precise, highly sensitive Doppler data processors.

Raytheon CW Radar Systems incorporating these advances are light weight, low volume and low cost. They are also simple, reliable, and require considerably less input power.

For satellite intercept, space rendezvous, lunar or planet soft landings . . . for any space application requiring velocity data . . . Raytheon can now offer *empirically proven* CW Radar techniques. Existing Raytheon CW hardware is now operational in Missile Guidance, Altimetry and Doppler Navigation Systems.

For CW Radar Brochure, write:

DIRECTOR OF MARKETING,
Equipment Division,
Department L-1, Raytheon Company,
West Newton, Massachusetts

RAYTHEON EQUIPMENT DIVISION

EXCELLENCE IN ELECTRONICS

Are you unknowingly flying second class in your own aircraft?

Many custom interiors *appear* to be of the highest quality until drawers and doors no longer seem to fit, fabrics begin to work loose or wear thin, colors almost imperceptibly begin to fade, seating and movement inside the aircraft becomes awkward and uncomfortable, and many weaknesses in basic design begin to be noticed.

Beneath the beauty and graciousness of any quality custom interior there must be good basic design. And good basic design requires outstanding engineering of a very specialized nature, fully integrating carefully engineered furniture and fittings into the framework of the aircraft.

AiResearch's extensive leadership and experience in the modification of all types of airframes and aircraft systems insures maximum integration of individualized interiors into the structure of the aircraft. This over-all capability, combined with good basic design, is also of vital importance to the safety and performance of the aircraft as well as to the beauty, comfort and durability of the interior.

Every AiResearch Aviation Service custom interior is built to retain its high quality for the lifetime of the aircraft. This is possible only because AiResearch employs the most skilled and experienced craftsmen in the industry and uses only the finest materials for the most rugged, lightweight construction throughout.

There is no production line at AiResearch Aviation Service, and no two interiors are alike. Every piece is hand finished by an expert craftsman with a genius for detail. And the internal construction and fitting of each piece is equally exacting. There is no compromise, and nothing is left to chance.

Before *you* should unwittingly decide to fly second class in your own corporate airplane, we urge you to check into the AiResearch Aviation Service Company reputation and facility to see for yourself how the finest interiors in the world are made.

Customer confidence is our most highly regarded asset

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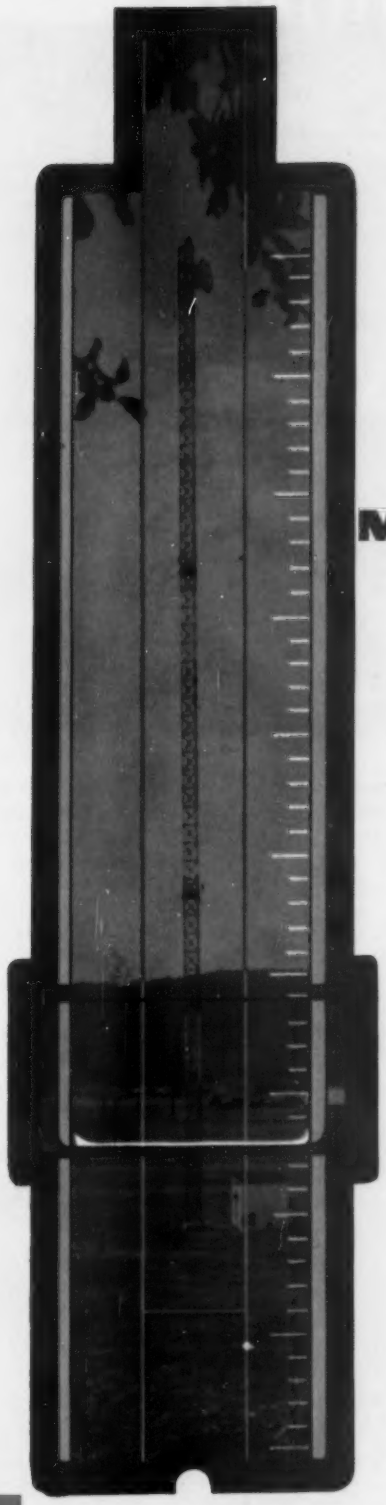

VERSATILE METAL FABRICATION

. . near Southwestern electronics and airframe manufacturers

In the center of the Southwestern complex of space-age activity is Continental-Emsco's huge steel fabricating facility. This versatile plant covers 77 acres . . 366,505 sq. ft. under roof. It's complete with machining, boring, milling, and turning equipment, spacious fabricating bays and creative staffs for engineering and Research & Development. Quality-control measures meet MIL-Q-9858 standards.

Versatility to handle any metalworking job is evidenced by this plant's production of propellant trucks, rocket launchers, crane trucks, marine gears, cargo winches, airframe parts, towers, and a complete line of oil field equipment. Illustrated is a typical 700′ triangular tower built by Continental-Emsco.

Get Continental-Emsco's quotations on your next equipment contract.

METAL FABRICATORS FOR INDUSTRY

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With national security at stake... missile base contractors fly

BELLS

There's a countdown underway throughout America as construction of our missile bases accelerates from day to day. Time is critical ... completion of the program is vital to national security and the Bell helicopter is *on the job*, speeding construction projects to completion *on schedule*.

One example: Western Construction Corp., on site at Lincoln Air Force Base, Nebraska, has turned "the impossible" into a time-saving reality by taking to the air in a Bell. Supervisors had been spending three days traveling by automobile to cover eight of 12 "hard" underground Atlas launching bases spread over a 500-mile road network. With their Bell, the same travel takes only two-and-a-half hours. Supervisory travel overhead has been cut 66 per cent.

Western has put a second Bell to work to gain double effectiveness. They've found Bell helicopters so dependable, so economical to operate and maintain that they expect full payout of their investment in one year. What's more, the high availability (99 per cent) of their Bells gives Western a time advantage unequalled by other types of transportation.

The helicopter is a natural for turning *waste time* into *pay-off* time in many fields of work. Let us send you full information on the Bell's total flexibility for your business. Write or phone: Commercial Sales Manager, Bell Helicopter Company, Dept. 7.7B, Fort Worth, Texas.

Bell's 47J-2 can carry four persons and fuel for 200 miles at altitudes over 10,000 feet.

BELL HELICOPTER COMPANY

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BENDIX BRAKES–

SURE GROUND CONTROL FOR 150-TON GIANTS

There's good reason why most of today's commercial and military jets rely on Bendix brakes. Products of the world's most experienced brake manufacturer, they are specially designed and built to meet the extra-heavy ground control demands of these high-performance aircraft. In fact, "Brakes by Bendix" signifies safe, sure ground control—*whatever* the aircraft.

Bendix PRODUCTS DIVISION South Bend, IND.

Another hot job for Janitrol valves

In the Mach 2 all-weather Republic F-105D Thunderchief—an aircraft of striking capabilities—performance depends on a lot of little things. Janitrol pneumatic valves, for instance, belong to the second generation of Janitrol products for the jet and missile age, including high performance heat exchangers, regulators, and couplings—descendants of the well known Janitrol heaters. In these special fields you'll find Janitrol offers a unique combination of experienced designers, hard-headed production people, and superb plant facilities. Write for "Janitrol Resources," a recent brochure loaded with meaningful photos and relatively low-pressure sales talk. Janitrol Aircraft, 4200 Surface Rd., Columbus 4, Ohio.

JANITROL

A division of Midland-Ross Corporation

pneumatic controls • duct couplings and supports • heat exchangers • combustion equipment for aircraft, missiles, ground support

New Ways To See Fire...

Fenwal has developed two advanced methods of finding fire or overheat faster in aircraft and missiles.

Fenwal's FIDO (Fire Inspection Device Optical) permits a pilot to *visually* monitor potential danger areas from a remotely located control panel. He merely looks into a tube containing FIDO's optically oriented glass fibers to *see* the hidden area. Or, FIDO can be used by launching crews to check out blind areas in missiles and rockets. *Image resolution is as fine as use demands!*

Fenwal's Surveillance Detector sees fire or overheat that may occur in large volumes, eliminating the "misses" that may be present when point or line detection is used. It operates photoelectrically and is sensitive either to the first flicker of a flame or to heat radiation. It is "blind" to daylight and even the direct rays of the sun — *it "sees" only the potential danger!*

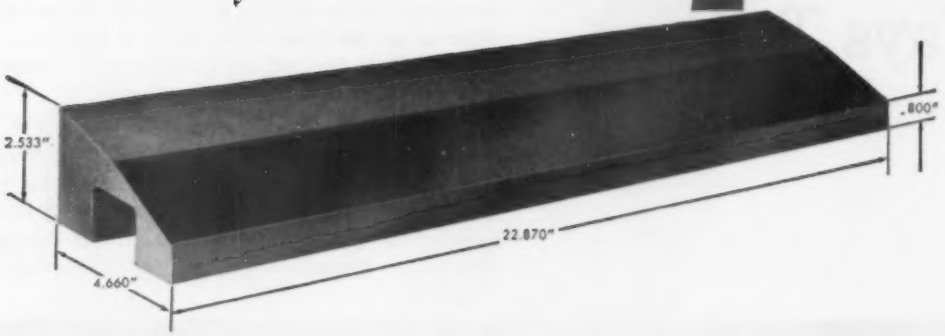
These advanced Fenwal safety devices are the end products of long and continuing research. They complement Fenwal's established capabilities in unit and continuous detectors, and explosion suppression. A Fenwal engineer will gladly supply details. FENWAL INCORPORATED, 1210 Pleasant Street, Ashland, Massachusetts.

Another example of how

Fenwal DETECTS TEMPERATURE . . . PRECISELY

Maximum Density in Limited Space

WITH FANSTEEL 77 METAL



HERE'S 120 lbs. PACKED INTO ONLY 0.109 CU. FT.

Fansteel 77 Metal—non-magnetic, easily machined and joined to other metals. No special handling required—it is non-toxic, non-radioactive. Used extensively in applications requiring maximum density in the smallest possible space: shields, counterweights for aircraft control parts, rotors, governors, flywheels, vibration dampers. Fansteel 77 Metal is also available in bars, rods, rings, disks and special shapes.

When you need to pack a lot of weight in a small space to lick any problem . . . for radiation shielding, vibration dampening, counter-balancing, etc . . . design around Fansteel 77 Metal. Your part will take up as little space as possible while providing the service required.

Whether you need extra density for shielding purposes . . . or just extra weight, Fansteel 77 Metal will do the job . . . and do it in less space because it's twice as heavy as steel, 50% heavier than lead, much stronger than cast iron.

If your problem requires the density of 77 Metal in a large area, Fansteel now has the facilities to provide finished parts or the metal in ingot or any form required. For example, the radiation shield shown above is 22.870″ long x 4.660″ x 2.533″ x 0.800″. It started as a blank which was designed to provide the minimum loss in both metal and machining time. This large blank was produced in the Fansteel plant by powder metallurgy methods . . . pressed, sintered, and then machined to customer's specifications.

Call in your Fansteel representative or send details to Metals and Fabrication Division,

FANSTEEL METALLURGICAL CORPORATION
North Chicago, Illinois, U.S.A.

Write for latest Booklet on Fansteel 77 Metal

FANSTEEL
HIGH TEMPERATURE METALS

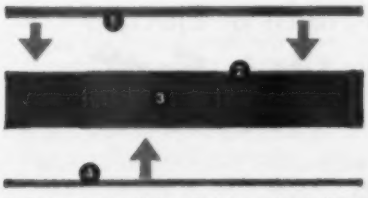
'K607

Johns-Manville Announces... MIN-KLAD INTERLOK

. . . a new structural system interlocking Min-K insulation and high-temperature reinforced plastic

Missile experience shows that in certain heat control situations no one material will perform as well as two (or more)—*an insulation with protective high-temperature facings.*

Problem is how to effectively combine these materials into a structurally strong unit? The answer is Min-Klad Interlok



1) Outer facing, 2) Interlocking web, 3) Core, any one of several Min-K formulations, and 4) Inner facing.

All the above components combine to provide a custom-made structural strong insulating system.

—a new structural system that interlocks Min-K insulation and reinforced plastic, metal or other high-temperature facings.

The result: one product that gives the missile designer every advantage of high-temperature plastic or metal foil—strength, toughness, rigidity! Erosion resistance! High heat capacity!

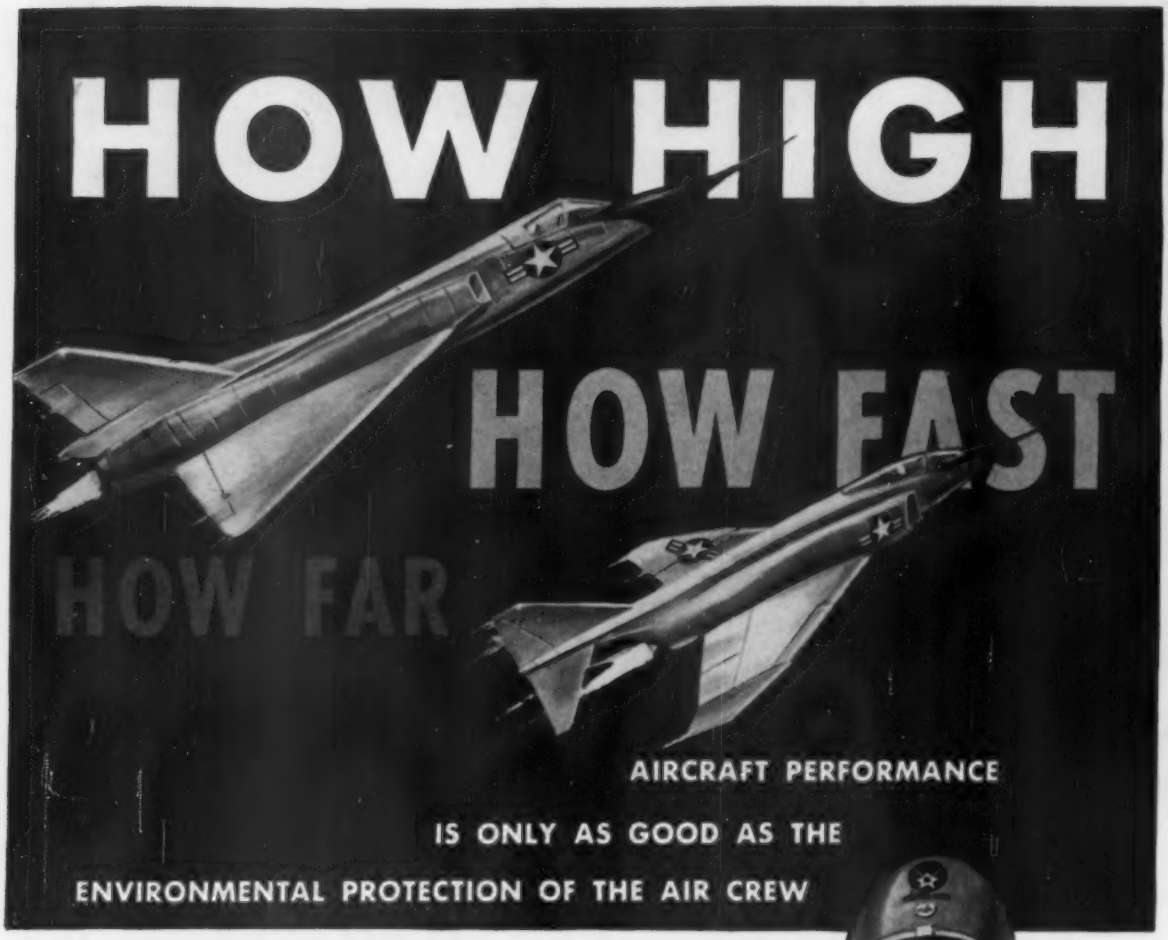
. . . plus the outstanding advantages of Min-K insulation—an insulating core that has the lowest thermal conductivity available for service temperatures up to 2000°F steady-state, and higher for transients. Min-K's thermal conductivity is actually lower than the molecular conductivity of still air.

Wide range of facings

For the hot face, the missile designer can specify Min-Klad Interlok in a wide variety of heat-resistant and/or ablating materials—asbestos-phenolic (ARP-40), and similar reinforced plastics, as well as stainless steel and other heat-resistant metal foils and meshes. For some requirements, the cool face can be made of a different material—for example, one that offers characteristics required for bonding or fastening to other surfaces and parts.

Like all J-M Aviation insulations, Min-Klad Interlok is factory-fabricated to your specifications into external skin panels, heat shields, cylindrical liners or component housings of any shape or size. Write today for technical specifications. Address Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS



SCOTT RESEARCH AND DEVELOPMENT PROVIDES THE MAN IN FLIGHT WITH THE MOST ADVANCED SYSTEMS OF PROTECTION AND SURVIVAL!

Environmental protection of the air crew is the important link between theoretical aircraft performance and actual flight records.

For more than ten years, Scott has designed and produced more portable oxygen equipment than any other manufacturer in the world. *Now,* Scott also leads in the design and production of high-altitude oxygen breathing equipment for protection during flight or ejection.

Scott High Altitude Protective Equipment has been designed, developed and produced in cooperation with personnel of cognizant Departments of Defense and prime contractors. The knowledge and experience of these scientists and engineers have been combined with our own efforts to make the U.S. Crewman the best protected in the world!

Dedicated, imaginative Engineers can find full expression for their talents at Scott Aviation Corp. Write in confidence to Walter H. Winter, Personnel Director.

In Flight or Ejected His Life is *Scott* Protected

The Scott Building-Block Design Concept integrates components block to block, to produce a completely-interchangeable, modular oxygen assembly that can be quickly removed, serviced and replaced without disturbing any other portion of the aircraft.

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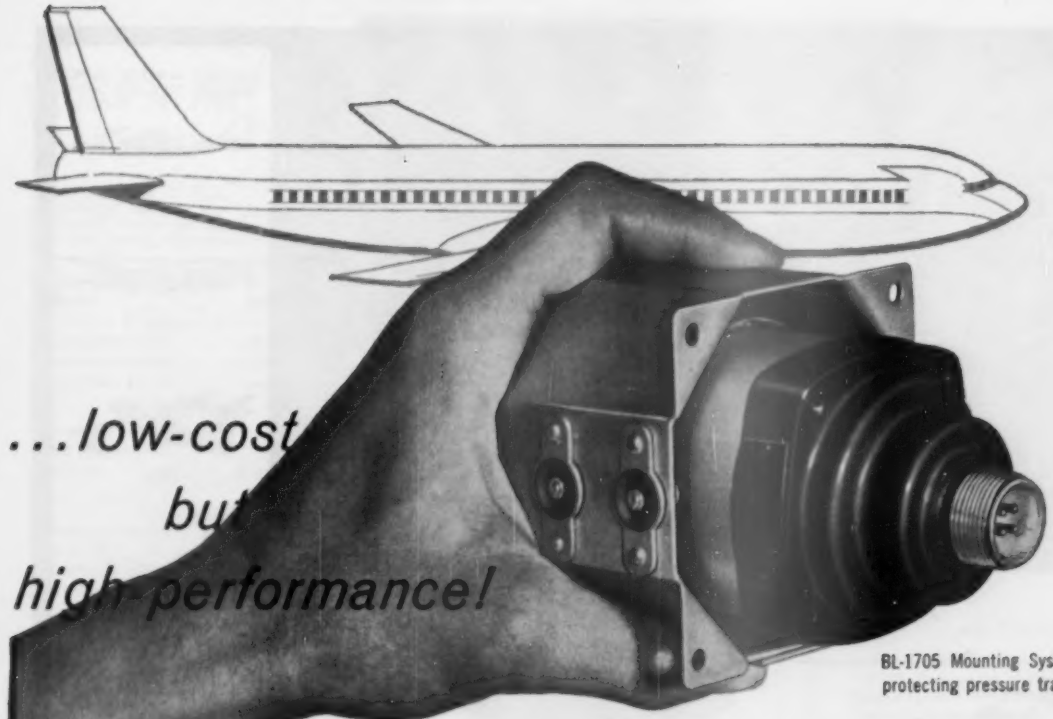

...low-cost
but
high performance!

BL-1705 Mounting System — shown protecting pressure transducer.

vibration control for aircraft instruments

Here's a new Lord mounting system for small equipment or instruments on jet aircraft that offers big advantages!

It's versatile. Basic design is adaptable to a variety of units: transducers, indicators, electronic tubes, gages, warning and timing devices, baroswitches. Mounting arrangements permit use in instrument panel, nacelle or other airframe locations.

It's high-performance. Lightweight system provides excellent all-attitude control of high-frequency excitations plus attenuation of shock and structure-borne noise. BTR® Elastomeric Mountings possess extreme environmental resistance, excellent damping, superior endurance, consistent performance over −65° to +300°F. range.

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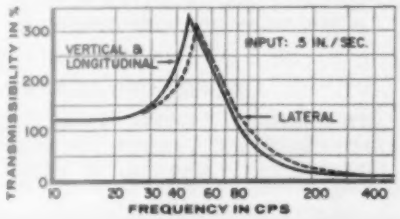

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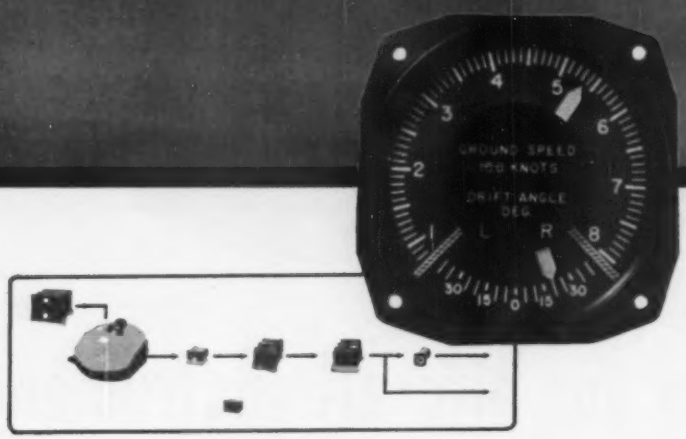

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COVER: Grumman A2F-1 Intruder, a carrier-based low-level attack bomber being built for the U. S. Navy, is shown equipped with four 300-gal. auxiliary fuel tanks mounted on weapons stations for long endurance missions. The side-by-side two-place Intruder is fitted with adjustable tailpipes, manufactured by Ryan Aeronautical Co., which provide STOL effect during takeoff. For other pictures, see page 66.

PICTURE CREDITS

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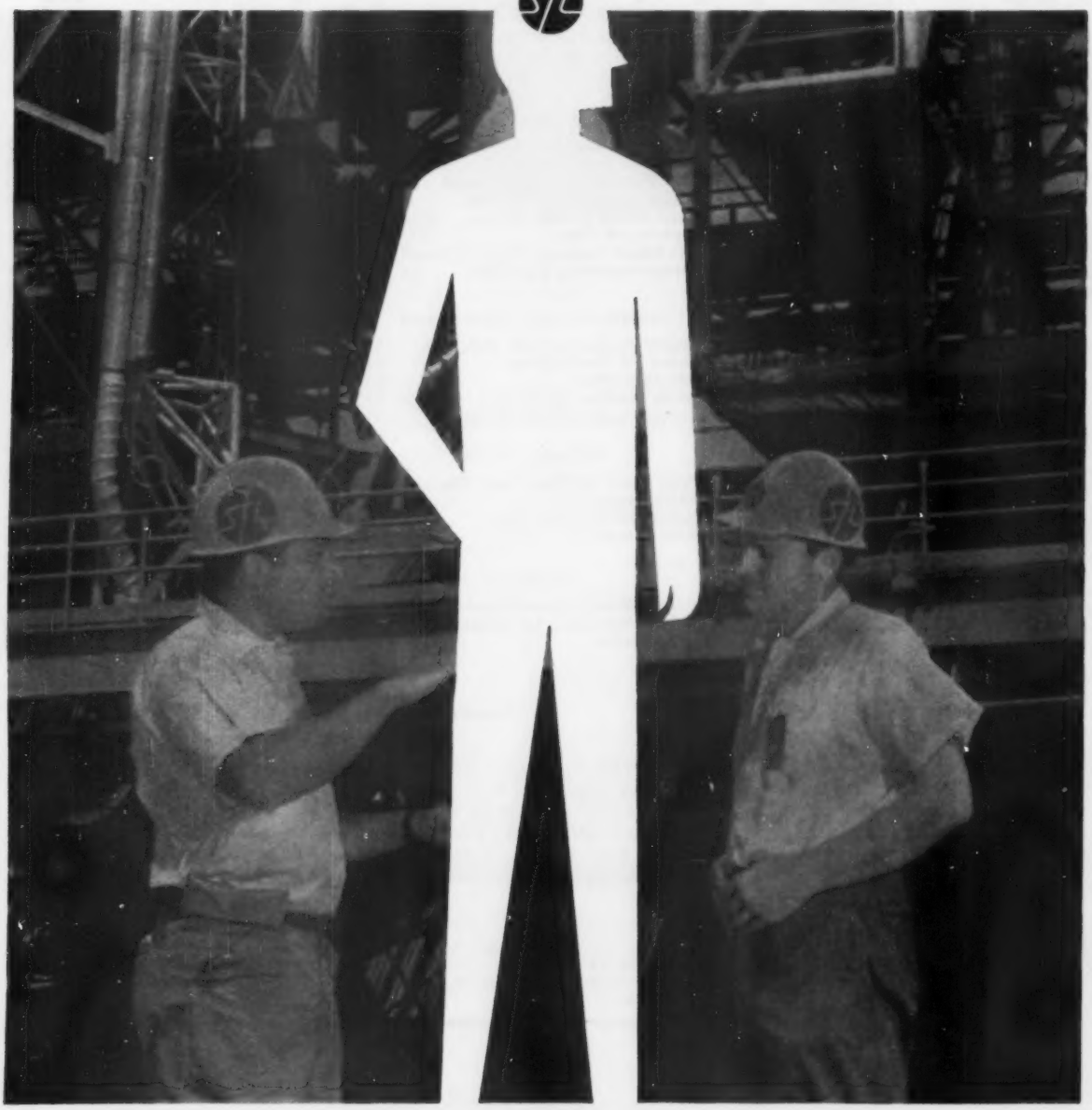

EDITORIAL

Kennedy on National Defense

(Last week we devoted this page to the principal points of Vice President Nixon's first major speeches on the defense issue. Since then, Sen. Kennedy also spoke on this issue before the American Legion convention in Miami Beach. We present excerpts from Sen. Kennedy's speech to assist our readers in determining where each candidate stands on this vital issue. We hope that both candidates will continue to discuss the defense issue and make their positions clear to the voters in the two weeks remaining before the election on Nov. 8—Ed.)

Democratic presidential candidate Sen. John F. Kennedy proposed major changes in military programs and their management last week as he told the American Legion convention in Miami Beach what he thinks is wrong with the nation's defense effort and how it should be improved. Kennedy wants these changes made:

• **Immediate steps** should be taken to protect the current U.S. nuclear deterrent force from surprise attack. Kennedy told delegates that 90% of the retaliatory force is composed of missiles and aircraft with "unprotectable bases whose location is known to the Russians." In his prepared text, from which he departed frequently, Kennedy also said this situation can be improved by providing Strategic Air Command with continuous airborne alert capability and by pressing such projects as Hound Dog, a missile which will improve bomber penetration capability. "We must also step up our lagging Atlas base program," he said. "For missiles without bases are worthless—adding nothing to our defense—and wasting our all too limited missile capacity."

• **Crash programs** should be accelerated on the "ultimate weapon"—the Polaris and Minuteman—"which will eventually close the missile gap."

• **Modern airlift** should be provided for the Army. Kennedy said conventional forces should be modernized and provided with turbine-powered airlift. "It doesn't do any good to have 17 divisions stationed here if you can't move them around the world within 24 or 48 hr. I would put that near the top. To move them by jet all around the globe will increase our forces substantially."

Sen. Kennedy also called in his prepared text for reorganization of the Defense Department. He said allocations, roles and missions should be realigned "in accordance with the logic of modern weapon systems and technology—transforming the Joint Chiefs of Staff into a defense level staff rather than the representatives of the three services—creating an authority which will be directly responsible for stimulating scientific research and discovery—and eliminating the duplication of function which has resulted from the creation of 39 separate civilian status offices in the Pentagon."

Outlining his indictment of Republican defense policies since 1952, Kennedy said the nation's military strength has not increased as fast as that of the Russians, particularly in ground forces, submarines and missiles. He pointed out that the U.S. has 17 ground divisions opposed to more than 150 Soviet armored and infantry divisions, and he sharply questioned the airlift capability provided for U.S. troops.

Kennedy told the convention that "our ability to meet our commitments to more than 50 countries around the globe has been critically impaired by our failure to develop a jet airlift capacity. Have you seen the pictures of the planes that flew the United Nations forces to the Congo? Or to Lebanon? How many of them were jets? And how long did they take to fly from West Germany to the Congo and back?"

The U.S. is moving into a period where the Soviet Union will be outproducing it "two to three to one" in missiles, Kennedy said, and he blamed this "dangerous deterioration" in U.S. military strength on "our willingness to cut our budget, to bear a military burden which is not large enough, if we're going to maintain our freedom. And words are not a substitute for strength. These are the facts behind our speaking louder and louder while we carry a smaller and smaller stick."

The Democratic candidate said it is in the issue of military power where the "Communist advance and relative American decline can be most sharply seen. And it is here that the danger to our survival is the greatest." In his prepared text, Kennedy said that when the Republican Administration took over eight years ago, "it inherited the most powerful military force in the history of the world—an America whose military supremacy was unchallenged and seemingly unchallengeable. The previous Administration had developed the first atomic and hydrogen bombs—built up the greatest atomic striking force in the world—developed, in the Navaho project, the rocket engines which are now used in the Thor ICBM (sic) and the Atlas ICBM—and so nearly completed testing for the Atlas ICBM that construction was about to begin."

Kennedy said that within a year, "the tide had begun to turn. The development of a relatively small hydrogen warhead had made missiles the key to future military power. The Soviet Union decided to go all out in missile development. But here, in the United States, we cut back on funds for missile development. We slashed our defense budget. We slowed up the modernization of our conventional forces—until, today, the Soviet Union is rapidly building up a missile striking force that endangers our power to retaliate—and thus our survival itself."

In support of his indictment, Kennedy cited such documents as the Gaither Committee Report and the Rockefeller Brothers Report, plus the congressional testimony of Republican defense experts and former military officials, and suggested the delegates check the record themselves.

"In fact, the only reassuring statements we have are the claims of those in power who want to stay in power—the soothing syrup fed to anxious Americans to make them forget the tragic mistakes of the last eight years: the cutbacks in our budget for research and development—the slashes in Army personnel—the impounding of funds voted by the Congress—the silencing of critics—the consistent overriding by the Budget Bureau of the requests made by our service chiefs for the funds they knew they needed to carry out the missions assigned to them," Kennedy said in his prepared text.

BURGOYNE IGNORES RECONNAISSANCE AND INVITES DISASTER

General "Gentleman" John Burgoyne was not one to fret over reconnaissance.

Saratoga, frequently called the turning point of the American Revolution, was the end product of a series of "no reconnaissance" battles fatal to Burgoyne's invasion force. Supremely confident as he swung southward from Canada, the British commander rarely knew where or what was ahead. St. Leger's British force, vital element in Burgoyne's campaign, disintegrated when its sizable Indian contingent vanished at news of a huge American counter force. Reconnaissance would have readily shown the Americans mustered a mere 1,000 men. Along his march, Burgoyne dispatched his grenadiers to reinforce a Hessian advance unit at Bennington . . . as usual, without adequate reconnaissance. The grenadiers did not discover until after they were decimated by a Colonial force that the Hessians had already been wiped out. Finally, Burgoyne's confused and weakened men, alone and completely ignorant of enemy forces, surrendered at Saratoga.

Throughout the history of warfare, successful field commanders have based command decisions on proper reconnaissance. Burgoyne ignored history and the obvious need for strategic and battlefield reconnaissance thus committing a series of faulty command decisions and helping to assure the success of the American Revolution.

From the beginnings of communities on the face of the earth, reconnaissance has helped shape history. Today CAI's specialty in this area is helping shape history to the advantage of the Free World. Typical of CAI contributions are: **V.I.P.** Visual Integrated Presentation, data display system; **KA-30** the world's most versatile aerial camera; **SOLO** the only electro-optical "available now" guidance system.

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WHO'S WHERE

In the Front Office

Sterling B. Withington, board chairman and chief executive officer of Doman Helicopters, Inc., Danbury, Conn. **Glidden S. Doman** continues as president. Mr. Withington is the retired president of Avco's Lycoming Division.

Cameron G. Pierce, John F. Bishop and **Harry W. Hoagland,** directors of Radar Relay, Inc., Santa Monica, Calif. Mr. Pierce is president of Ling Electronics Division, Ling-Temco Electronics, Inc.; Mr. Bishop, executive vice president of Textron Electronics, Inc.; Mr. Hoagland, vice president of American Research and Development Co.

Walker G. Dollmeyer, vice president-operations, Stratford, Conn., plant of Lycoming Division of Avco Corp.

Walter I. Shevell, vice president, Giannini Controls Corp., Duarte, Calif. Mr. Shevell continues as group manager of the Gyro and Servo Component Divisions.

Will W. Sawdon, vice president-manufacturing, Kaman Aircraft Corp., Bloomfield, Conn. Also: **Harlan S. Hosler,** assistant vice president; Mr. Hosler continues as manager of Kaman's Washington (D. C.) office.

William L. Davis, executive vice president, Emerson Electric Manufacturing Co., St. Louis, Mo. Mr. Davis will serve as general manager of the Electronics and Avionics Division.

Maj. Gen. William M. Morgan (USAF, ret.), vice president-military relations, Beech Aircraft Corp., Wichita, Kan.

Richard C. Henshaw, vice president-operations, and **Stephen W. Carter,** vice president-industrial relations, Lord Manufacturing Co., Erie, Pa.

James P. Malmstrom, vice president, Koehler Aircraft Products Co., Dayton, Ohio.

Emo D. Porro, vice president-operations, Arnoux Corp., Los Angeles, Calif.

Litton Systems, Inc., a subsidiary of Litton Industries, Inc., Beverly Hills, Calif., has appointed the following as vice presidents: **Bruce A. Worcester,** director-product support; **Harold F. Erdley,** director-Guidance Systems Laboratory; **Dr. Norman Enenstein,** director-Tactical Systems Laboratory; **Dr. Thomas P. Cheatham, Jr.,** director-Advanced Development Laboratory.

Frank Nichol, a vice president, Houston Fearless Corp., Los Angeles, Calif. Mr. Nichol will assume administrative direction of the Houston Fearless East Coast Federal Group.

David G. Fladlien, special assistant to the vice president for administration and finance, Space Technology Laboratories, Inc., El Segundo, Calif.

John W. Bridges, head of a new aircraft fire and rescue program in the Airport Division of the Federal Aviation Agency's Bureau of Facilities and Materiel.

Lt. Col. Ralph R. Springer, director of the Office of Information, Wright Air Development Division of the Air Research and Development Command, succeeding **Lt. Col. Milton Frank** who is now chief of the Air Materiel Command's Office of Information, Wright-Patterson AFB, Ohio.

(Continued on page 103)

INDUSTRY OBSERVER

► Watch for an announcement of Defense Department decision to push ahead with multi-million dollar anti-ICBM defense system employing polar orbiting satellites. Designated Project Spad for satellite protection for area defense, the system will be developed by Convair, Boeing and Thompson Ramo Wooldridge. Spad satellites would provide early warning to ground-based anti-missile missiles and later might themselves carry anti-missile projectiles (AW Jan. 4, p. 18).

► **Project Saint satellite intercept program now is funded for $60 million on a three-year basis as a high-priority USAF effort under technical supervision of Aerospace Corp. Initial effort will be a feasibility study involving some design work. Proposals are due from industry by the end of this month. Indications are that the program may be removed from Advanced Research Projects Agency's general supervision.**

► USAF is supporting several parallel studies of later-generation satellites capable of maneuvering to avoid interception by hostile vehicles. Contracts are funded through Wright Air Development Division.

► **Lockheed Azcarate S. A. still expects the first production model of its LASA 60 single-engine light utility aircraft (AW Apr. 25, p. 95) to fly by the end of the year, although production has slipped to December from earlier date of late October. The lag is due to shipping delays, legal formalities at the border when jigs and other machinery were moved from the Marietta, Ga., plant, and relocation of the plant site from a point outside Mexico City to San Luis Potosi.**

► Air Force Command and Control Development Division is expected to merge several electronic support system projects under one System Program Office. Action will be in line with Winter Study Group recommendation for improved integration between systems (AW Oct. 17, p. 32).

► **Space reconnaissance equipment employing a tube that converts infrared images into video signals is being developed on a very tight time schedule under an Aerospace Corp. contract. Space Technology Laboratories has development responsibility, and associate contractors are General Electric, Philco, Lockheed and Fairchild Camera's Dumont department.**

► Rhein-Flugzeugbau GmbH. of West Germany is developing a turbojet-powered version of its RW.3 Multoplane (AW June 20, p. 284). Company hopes to gain government support for the aircraft as a primary jet trainer.

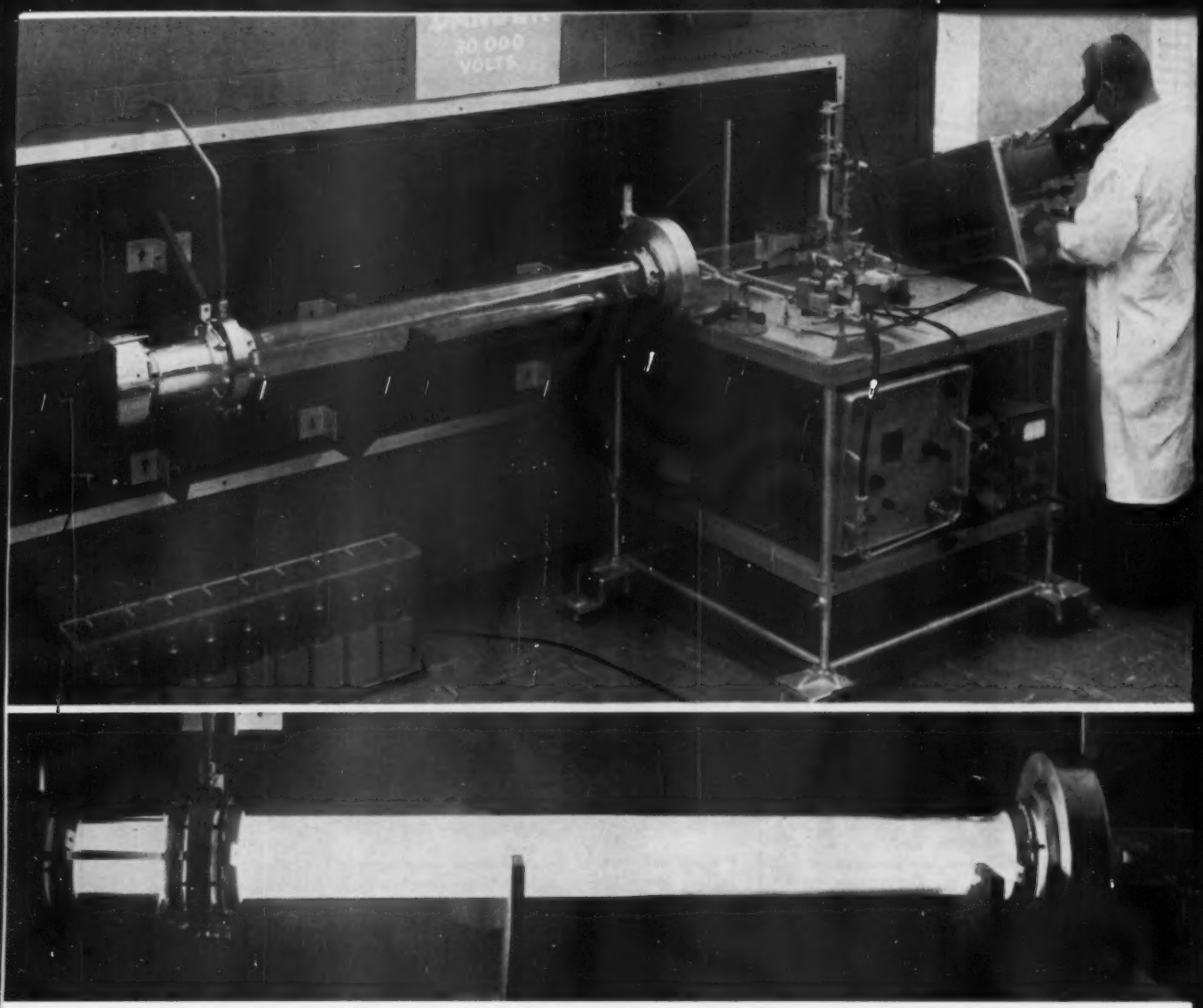
► **NASA has asked representatives of about 20 universities to help it analyze meteorological data obtained from the 23,000-odd cloud cover photographs returned by the Tiros I satellite.**

► Requirements of military satellite support systems are to be assessed by Douglas, Convair, Lockheed, Martin, Northrop and General Electric under one-year studies funded by Wright Air Development Division. Program is called Slomar, for space logistic maintenance and rescue, and will cover vehicle rendezvous for repair and rescue or removal of personnel from future space stations.

► **USAF has no immediate plans for launching major new electronic support system programs, except for Norad Combat Operations Center (425-L) which was shelved during Fiscal 1960 budget battle but may be funded in Fiscal 1961.**

► Nike Zeus anti-ICBM test launch site on Kwajalein Island is expected to be ready for use by May or June, but there is doubt that modified Atlas ICBM target missiles will be ready to meet the project schedule. Decoy capability is one modification required for Atlas under the broad penetration aids program planned for the tests.

► **Next launching of NASA Atlas-Able V vehicle carrying a Pioneer VI lunar orbiter payload is scheduled tentatively for the Dec. 13-18 period from Cape Canaveral, Fla.**



PLASMA AND PROPAGATION Electromagnetic attenuation as a function of frequency, and magnetic window techniques to alleviate the propagation problems, have been predicted and verified with the Bendix electrically-excited shock tube. These are the keys to future communication with hypervelocity vehicles. Career positions are open in both theoretical and experimental plasma physics, and communications.

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Washington Roundup

NASA Budget Review

Space officials met in Williamsburg, Va., last week to discuss problems and take a look at some new budget needs. Top staff officials from National Aeronautics and Space Administration headquarters and the agency's centers attended the meeting.

Supplemental budget request to launch new communications satellite development programs is one likely result of the Williamsburg session. NASA Administrator Keith Glennan has announced that his agency is preparing plans for a lightweight active repeater satellite to orbit at 3,000-5,600 mi.

NASA also wants to move ahead with the passive reflector satellite program it launched with the highly successful Echo sphere. The agency wants to try a more rigid inflatable sphere on its next test, using one of a number of possible techniques to give the satellite greater structural strength in orbit. This approach is considered cheaper in the long run, since Echo met all the objectives for a non-rigid sphere and another test would produce little new data.

There is no money available in the current budget for either of these communications satellite programs. NASA will have to get some extra money early in the next congressional session, which starts in January, if it is going to launch an active repeater next year as planned. More money will also be required to produce a rigid sphere for the next Echo shot.

These new programs will raise questions of conflict with military communications satellite programs. Army is developing active repeaters in the Courier and Advent projects. Senate Aeronautical and Space Sciences Committee is concerned over possible duplication and will warn against its dangers in a report on space programs.

Philippine Bid Delayed

Civil Aeronautics Board has delayed action for two weeks on the Philippine bid for a Manila-San Francisco route via Tokyo. The Board postponed hearings on the controversial request from Oct. 25 to Nov. 9 at the request of Northwest Airlines. The carrier said its workload on other CAB cases would keep it from devoting full attention to the case, which could have an important competitive effect on Northwest.

Philippine government is asking for the transpacific route for Philippine Air Lines despite its denunciation of the U. S.-Philippine bilateral. It is standing firm on its contention that flight frequencies of U. S. carriers to Manila should be restricted and duration of their operating rights should be limited. CAB is expected to grant the route to Philippine Air Lines, but with the proviso that it will be canceled if U. S. carriers are restricted.

U. S. is against capacity restrictions in this fight, which differs from the recent dispute with the Scandinavians. U. S.-Philippine argument is over traffic flying primarily between the two countries. Scandinavian dispute is over U. S. attempts to restrict traffic traveling beyond the countries involved.

Dr. George Kistiakowsky, the President's scientific adviser, will stay on the job until a new Administration takes over in January. There have been reports that he would return to Harvard University before President Eisenhower left the White House.

Management Dispute

Question of who should manage the electronic ground support system for Midas and Samos (WS-117L) is producing some friction. The choice lies between Air Force Ballistic Missile Division and USAF's Command and Control Development Division. Management responsibility for the WS-117L data-processing system, under development by Thompson Ramo Wooldridge, recently was transferred from BMD to CCDD. But BMD retains managament of the WS-117H ground tracking-comunication equipment Philco is developing.

Commerce Department hopes to report to industry within a month on government efforts to facilitate and increase aeronautical exports. Industry made a number of recommendations at a recent government-industry conference, including pleas for simplified procedures and more liberal financing for nations buying U. S. aeronautical products. Commerce now is studying the proposals to see what changes can be made.

Air Transport Assn. is continuing its fight against Civil Aeronautics Board attempts to obtain disputed documents in its investigation of ATA. The Board asked the U. S. District Court for help in forcing ATA to produce the documents, and the association has told the court the only papers it withheld are those it maintains are "legally privileged."

ATA blamed the Board for delays in the investigation, maintaining that the only obstruction has been CAB's suspension of the investigation July 17 despite the association's request that it be continued.

—Washington Staff

Space Technology

USAF Accelerates Bioastronautics Effort

Research command seeks to help nation regain lead from Russia by better coordination, streamlining.

By Evert Clark

Washington—Air Research and Development Command has begun streamlining and accelerating its bioastronautics research to help regain a leadership that it believes the nation has lost to the Soviet Union in this field.

The new effort will include modest increases in funds for certain critical areas. Revision of this work will affect all Air Force medical research units to some degree, including those outside the command. It has two major goals:

- **To reflect more adequately** the broad technical scope and depth of biomedical competence that ARDC must have to meet the strenuous requirements of military manned space flight programs such as the Dyna-Soar boost glider.
- **To put USAF in a better** position to augment quickly any national civilian space flight program. Having this capability is almost as important a requirement for ARDC as supporting military weapon systems, since the services—and primarily the Air Force—are providing most of the biomedical support for National Aeronautics and Space Administration's Mercury and Apollo man-in-space projects.

Lt. Gen. Bernard A. Schriever, ARDC commander, last week named Brig. Gen. Don Flickinger staff supervisor for the command's bioastronautics research program. Gen. Flickinger already was Gen. Schriever's assistant for bioastronautics.

New Clearing House

The new assignment establishes Gen. Flickinger's office as a central point of information on applied bioastronautics research within the Air Force as well as a central point of review and approval for most of this work done within the command.

He is given a clean line of communication directly to biomedical research personnel in three ARDC laboratories—the Aerospace Medical Division at Wright Air Development Division; the Aeromedical Field Laboratory at Air Force Missile Development Center, and the Personnel Laboratory at Lackland AFB. Systems oriented biomedical and human factors work at other centers will not come under Gen. Flickinger's direct supervision.

This action removes center and division commanders, who would require a system of staff checks and balances in order to understand and supervise biomedical work, from the communication channel.

Although this might appear to be a centralizing step—in opposition to ARDC's recent attempts to decentralize authority from headquarters to the division level—the command believes that the only way to decentralize authority to the laboratories and still accelerate the biomedical effort is to have headquarters biomedical men dealing directly with field biomedical men, eliminating other personnel between them.

Clearing House

Gen. Schriever has obtained concurrence from the Aerospace Medical Division in the USAF Surgeon General's office, the Human Factors Division in the Directorate of Development and the Air Training Command's School of Aerospace Medicine that ARDC will have centralized cognizance of biomedical research. This does not mean that the command will be responsible for or will direct laboratory programs outside ARDC, but that it will serve as a clearing house of information on what work is being done so that the over-all Air Force program is well integrated.

Samos Recovery

Technique for midair or surface recovery of the Samos experimental reconnaissance satellite payload (AW Oct. 17, p. 28) is being worked out by Radioplane Division of Northrop Corp., in cooperation with Lockheed Aircraft Corp., Samos prime contractor.

Midair recovery technique will be similar to Discoverer air snatch, with trajectory-monitored capsule retrieved by vectored aircraft. Tests at El Centro and Pt. Mugu, Calif., will involve taking simulated Samos components to 40,000 ft.

Recovery also includes use of inflatable bags to cushion capsule shock, similar to those developed for Mercury man-in-space capsule; one drop off Pt. Mugu for water recovery has been successful. Besides the bags, system includes stabilizing chute, air pickup chute, and a main recovery chute. Radioplane has also delivered the system to Lockheed for further tests.

Among the reasons underlying the latest action are:

- **Gen. Schriever's conviction** that manned systems, both for atmospheric flight and space flight, will be required well into the future.
- **An analysis of all** Air Force bioastronautics work, which indicated that the service's long experience and appreciable resources could be put to better use under the new system.
- **Need to meet immediate** biomedical requirements, such as those for Dyna-Soar, more quickly.
- **Recognition that lead time** in the biomedical field is perhaps more critical than it is in other branches of space technology.
- **Need for greater cognizance** of and integration with NASA programs.

ARDC frankly believes that it does not have the knowledge it needs to answer either the survivability or performance questions involved in manned space systems.

NASA is being forced in the Mercury project to go from the high performance aircraft, where man's usefulness as a key part of the system had been proved, into the unknowns of the Mach 18-20 speed, temperature and forces envelope without an orderly progression of biomedical research.

To make man a military useful part of a space system requires making far more determinations in the biomedical area than simply including him as an operator-scientific observer in a project such as Mercury.

Orderly Progression

ARDC does not feel it can safely extrapolate the biomedical information available from Mach 6 flight in a manned X-15 to the military situation represented by atmospheric and orbital flight in a vehicle such as Dyna-Soar without making the orderly progression that Mercury is being forced to skip.

To work with assurance on the biomedical aspects of a vehicle system that is to fly, for example, three years from now, biomedical men would prefer to have their biomedical knowledge already extended three to four years beyond the flight date. Seven years is considered a good comfortable lead time for this kind of capability.

ARDC feels that the U.S. pioneered space medical research beginning with monkey and mouse flights in Aerobee rockets around 1949, and held a clear world leadership until budget and policy decisions caused most of the work to be discontinued in 1952.

Russia, on the other hand, borrowed directly and heavily from the U.S. efforts, and in 1953 began what ARDC

researchers describe as an expensive and healthy program of space biomedical work that has continued through Sputnik V—and has clearly taken the lead away from the U.S.

Air Force again lost time in its biomedical space work during the long post-Sputnik debate about who should do what in the new national space program. Its man-in-space program was shifted first to Advanced Research Projects Agency's supervision and later to NASA's.

After USAF lost the man-in-space program around August of 1958, ARDC's biomedical research officers met and prepared their own version of a comprehensive national program of space medical research, including work that should be done to support both civilian and military programs.

This was given to NASA, Defense Department and the Armed Forces-National Research Council Committee on Bio-Astronautics. The plan included advanced facilities and would have been expensive to implement. It did not specify who should do what work. Much of it still has not been implemented.

NASA did not establish its Office of Life Science Programs until March, 1960, a year and a half after the agency was created. In the interim, USAF and other service medical laboratories worked closely with NASA headquarters and NASA's Space Task Group, which is in charge of Mercury.

Because of the curtailment of space research early in the 1950s and the time lost after Sputnik, the lag of bioastronautics development behind that in other fields has become critical.

In other technical areas, advancement has been rapid. Materials, for example, are better understood and fundamental changes can even be made in their nature. Man has not changed appreciably since he evolved into man, and the problems of protecting him are greatly compounded when large jumps in technology carry him into more hostile regimes. He still must take his environment with him, and it is perhaps affected more than any other subsystem by the extreme conditions of new regimes.

ARDC would like to restore the situation that held before space flight began, in which military aeromedicine stayed well ahead of the needs of civil aeromedicine—just as speeds, altitudes and ranges of military aircraft stayed well ahead of those of civilian aircraft.

Funding of bioastronautics work could increase under a new administration. But with its mission in space still somewhat limited, Air Force now expects to have to do more with less by realigning procedures and assigning priorities so it can increase its competence within a fixed annual budget.

Mercury-Redstone Shots Delayed; Manned Orbit Still Due Next Year

Washington—Series of component malfunctions and failures has delayed launch of the first Mercury-Redstone capsule until next month, complicating the tightly compressed Mercury flight schedule and forcing postponement of the first manned Redstone ballistic flight until next year.

Despite schedule slippage, National Aeronautics and Space Administration still feels its Mercury approach is sound. The agency refuses to blame launch delays on the engineering judgments of Mercury managers or contractors, attributing the situation instead to a too-optimistic timetable for prelaunch system checkout.

Checkout schedule did not allow for system failures and subsequent repair. The schedule has proved unrealistic, and the lack of provision for checkout failures has been the major block to meeting target flight dates.

First Redstone-boosted capsule, designated MR-1, has been at Cape Canaveral several weeks (AW Oct. 3, p. 32), and NASA acknowledges that the prelaunch capsule checkout has exposed a number of unsatisfactory components. Among them have been a damaged receiver in the command radio, faulty transmitter chafed wire bundle, faulty retrorocket circuit and several blown fuzes.

NASA does not consider that these faults stem from poor quality control, but rather should be considered as normal problems in engineering development of a new system.

Quality Control Shared

Quality control inspections for Redstone capsules are conducted both by McDonnell Aircraft Corp., the prime contractor, and by NASA at the McDonnell plant, at Huntsville and at Atlantic Missile Range. Navy and Air Force inspectors also check subsystems at subcontractor manufacturing plants.

All Redstone and Atlas Mercury capsules are production vehicles capable of orbital flight. NASA feels it is developing an experience factor for manned flights in the system checkout with MR-1, and that this factor will provide the basis for prelaunch and countdown techniques in all subsequent flights.

Adding to delay in the MR-1 project was a series of tropical storms at Cape Canaveral. The Redstone booster, erected two days before arrival of Hurricane Donna, was dismantled until the storm passed. Although Hurricane Florence did not hit the area, it dumped heavy rains on Florida and caused postponement by several days of the booster-capsule mating schedule.

The Redstone booster is now on the pad, and the capsule is in the NASA hangar at Cape Canaveral undergoing its final electronics and mechanical sequencing checks.

NASA says Mercury follows the practice with most space vehicle projects. The booster and payload are assembled three weeks before launch to check system compatibility. The payload then is taken to the NASA hangar for component checks.

Manned Flight Schedule

Frequently announced objective of a manned Redstone ballistic flight before the end of this year is now impossible, but NASA contends that the ultimate objective of Mercury—manned orbital flight—will be met by the end of next year. Manned ballistic flights could begin in January or February of the coming year.

Extensive discussion and speculation regarding the Mercury schedule—by top officials of the Defense Department, congressmen, industry and NASA

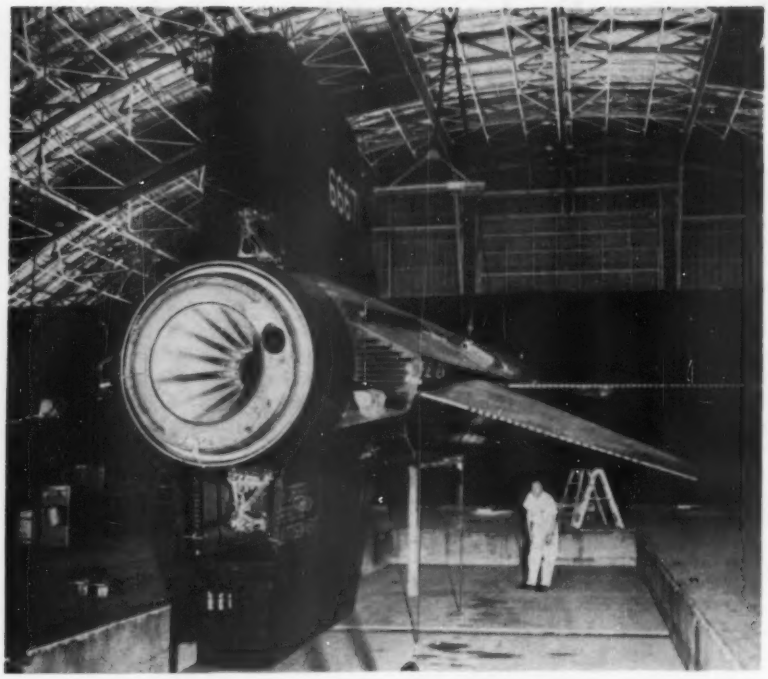
Fairchild Starts New Cost-Cutting Program

Intense scrutiny was under way last week of all Fairchild Engine & Airplane Corp. activities—including the F-27 turboprop transport program—in a new cost-cutting program begun with the resignation of James H. Carmichael as president and Board Chairman Sherman Fairchild's assumption of temporary operating control (AW Oct. 10, p. 33).

The company has been meeting frequently with its New York bankers, who may influence to a large extent the continuation of such programs as the aluminum boat venture, the Armalite Division's light military rifle programs or others, as well as the F-27 program.

Concern over future of the F-27 was evident at a local service forum which opened the Air Transport Assn. Engineering and Maintenance Conference at Kansas City last week (see p. 42). Spares supply was a major concern, but one carrier—Ozark—which wants to order more F-27s—pointed out its future overhaul planning has been left in an unstable condition because of the question over future production of the airplane.

Reductions in personnel at Hagerstown, Md., the company's headquarters, have included the recent dismissal of nearly 100 management employes.



X-15 Gets Replacement Engine

Series of ground runup problems, mostly in fuel system, has caused U. S. Air Force to install a replacement Thiokol XLR-99RM-1 57,000-lb. thrust engine in the No. 2 North American X-15 (AW Oct. 17, p. 32). First flight has been canceled twice. Plane may fly with the new engine late this week, after new runup tests scheduled to start today.

itself—is a matter of deep resentment at the Mercury program operating level. Working group feels these statements succeed in maneuvering them into the awkward position of being unable to meet illogical deadlines. They believe schedule slippage is due to legitimate development delays, not poor management, but extensive publicity makes delays awkward to defend.

NASA maintains that although the Mercury program "has had its share of bugs," the situation has not reached the point where design changes are required. One Mercury official said the major fault in the program has been simply the allotment of too little time for checkout, that difficulties found have been "of the same nature as the designer finds in a new car."

Space Task Group at Langley Field, Va., has maintained that the schedule will not take precedence over the development program. Shortly after the group was formed, a spokesman told AVIATION WEEK Mercury would be based on sound procedures, and "NASA will stick by them." The program will closely follow development techniques of the X-series of airplanes, which resulted in a single NASA pilot fatality in 15 years of flying.

NASA recognizes that if there is a fatality in the first flight, public reaction will be that there was an error in the design judgment, and faith in the concept will therefore be destroyed.

NASA is banking a considerable part of its reputation and judgment on Mercury as the basis for engineering and human factors research in the multi-man Apollo spacecraft project (AW Sept. 5, p. 26). The Mercury program, consequently, is certain to have a major effect on congressional support for the Apollo budget.

While the Redstone flight hardware checkout is under way at Cape Canaveral, the seven Mercury astronauts last Friday ended a Redstone mission profile training program on the Navy's Aviation Medical Acceleration Laboratory centrifuge at Johnsville, Pa. Each astronaut went through five dynamic and three static runs, undergoing up to 16g accelerations.

Navy Seeks Savings In Procurement Costs

Washington—Navy has launched a major effort to control and reduce costs in procurement operations, instructing its personnel to make "systematic and vigorous efforts" to save money and encouraging industry to be more cost conscious.

Major Navy and Marine Corps procurement commanders were instructed last month to make a determined effort to find new ways to save procurement funds, and they are to report next week to Assistant Secretary of the Navy (Materiel) Cecil P. Milne on what they have done and plan to do under the program. Progress reports also will be required in January and June.

Navy cost-cutting effort was launched by Navy Under Secretary F. A. Bantz in a letter to procurement officials. Bantz said the Navy has "virtually exhausted what can be done by policy statements" and that direct efforts must now be made to put economy policies "fully into practice."

Procurement starts with operational requirements, Bantz said, and continues through their translation into specifications, items and quantities. Planning, administrative, technical, purchase, audit and inspection personnel make a team whose work reflects any weaknesses of its members, he said.

In a related action, the Navy will require about a dozen major aircraft and missile suppliers to present plans on cost cutting. Although no statement was made on a fixed price procurement policy, some steps in that direction will be taken by reaching firm prices earlier in production programs to stimulate greater cost consciousness in the planning departments of contractors.

In the area of requirements determination, Bantz ordered buying only what the Navy needs, using available Defense Department assets and avoiding development of new items when commercially produced material will do. Need for setting realistic delivery dates and avoiding changes after production has started were emphasized. High value item inventories are to be held to a minimum.

In procurement planning, Bantz warned against hasty buying, earlier termination decisions and early planning for component "breakout."

To increase competition, it was suggested that proprietary data be procured only when it is in the Navy's interest to do so, and in choosing companies not to look for opportunities to restrict business to one company but to encourage competition. Closer scrutiny of subcontractor costs also was ordered.

To stimulate cost consciousness, it was suggested that:

- **Technical documentation** purchased be held to a minimum.
- **Over-engineering** be avoided.
- **Value engineering** and incentives to contractors be emphasized.
- **Technical groups** be required to select the lowest cost developmental projects consistent with acceptable results.
- **Specifications** be simplified and improved.

Training and supervision, negotiation and price analysis, and especially contract administration will also be given a hard look and measures taken to tighten them, Bantz' directive said.

Explorer VII Continues Sending As Timer Fails to Silence Radio

Washington—Timer to turn off Explorer VII transmitter had not worked late last week, and the 91.5-lb. satellite was continuing to transmit radiation data.

Chronometer-timer was preset at launch to stop data transmissions 8,540 hr. after the satellite went into orbit Oct. 13, 1959, in a Juno II launch.

Satellite is orbiting with an apogee of 671 mi., a perigee of 344 mi. and period of 101.2 min. In its first year, it completed 5,190 orbits and furnished valuable radiation data that covered 1,200 mi. of magnetic tape.

Bulova Watch Co. timer (AW Oct. 10, p. 31) was built on short notice and was included in the Explorer payload to free the 20 mc. frequency, after a year of operation for later experiments. The timer has a 9,000 hr. lifetime, but it was not known whether it will shut off the transmitter when the clock's life expectancy expires next month.

Timer operates on the pendulum principle, with an oscillator replacing the pendulum for space operation and a tuning fork ticking off the time.

When the present hour-after-launch was reached, the timer was to have functioned like an alarm clock, closing a microswitch to silence the transmitter.

Report on the timer came in a conference in which NASA summarized the information which Explorer VII produced during its first year of operation. Explorer VII experiments and major results include:

• **Heat balance,** designed by Dr. Verner E. Soumi of the University of Wisconsin, using six sensing elements to measure heat received by the earth from the sun, and loss of heat from the earth to space. Conclusion from data reduction is that heat loss is largely controlled by clouds. A frontal zone relationship was established to verify this theory by combining pictures transmitted by the Tiros weather satellite with data from the Soumi experiment over the same areas as the pictures.

• **Cosmic ray,** sponsored by Dr. James A. Van Allen of the State University of Iowa. Apparatus consists of two Geiger counters to map and monitor the inner and outer radiation belts and determine the origin of auroras. Most spectacular finding of this experiment occurred Nov. 28 when the satellite went over the top of an aurora over Montana as the outer Van Allen radiation belt was dumping particles into the aurora. Data indicated that the outer belt was stable the day before and the day after the aurora, but the profile of the belt was highly irregular Nov. 28.

• **Heavy cosmic ray,** originated by the late Dr. Gerhard Groetzinger of the Research Institute for Advanced Studies, Martin Co., to investigate the energies of primary nuclei heavier than carbon. It was found that quantities of heavy cosmic rays differ significantly with time of day, the total number of particles counted is inversely proportional to the energy of the particles, and these heavy particles apparently originate from solar disturbances.

• **Micrometeorite impact,** sponsored by Herman E. Laggow of Marshall Space Flight Center, who was NASA project manager for Explorer VII. Experiment consisted of three cadmium sulphide detectors covered with aluminum-coated mylar. One cell was damaged on launch, and another sent no data during its 38-day lifetime. Data on the third detector indicated that it was penetrated either by molecular sputtering or micrometeorites, which made a hole about .001 in. in diameter during its 13-day lifetime.

• **Lyman alpha X-ray radiation,** sponsored by Dr. Herbert Friedman and Dr. Talbot Chubb of the Naval Research Laboratory, to measure intensities and time variations in solar emissions of ionizing radiation. Experiment was swamped by electrons from the lower Van Allen belt, and the device was redesigned and successfully flown as the piggyback Greb satellite on Transit II-A. Redesign included a magnetic shield, and the Greb satellite has demonstrated that solar X-ray emissions vary with flare activity, while solar ultraviolet emissions remain relatively constant.

WADD Test Facility

Dayton—Wright Air Development Division is building a $7.7 million addition to its ground test facilities which will permit simulation of the high temperatures and stresses such vehicles and the B-70 and Dyna-Soar will encounter.

The new test complex, which includes a data-processing facility, will be able to simulate temperatures up to 3,000F with radiant heating and will be able to apply up to 40 random, simultaneous loads in static and dynamic testing. It will handle vehicles as large as the B-70. Equipment is now in the final checkout phase, and the facility is scheduled to open in January.

Exports Increase 89% in First Half

Washington—Aviation exports of $703.8 million during the first six months of this year increased 88.5% over the same period last year, according to Aerospace Industries Assn.

The dollar-volume of exports in major categories was: aircraft, $254 million; engines, $13 million; aircraft parts and accessories, $320 million; engine parts and accessories, $90 million. Aircraft training and ground handling equipment, $26 million.

Here are aircraft export totals and the countries which were the major customers:

• **New commercial** passenger transports over 30,000 lb., $220 million. The main importers were: United Kingdom, $34 million; France, $33 million; The Netherlands, $30 million; West Germany, $22 million; Belgium, $21 million; Canada, $17 million; Sweden, $16 million; India, $14.7 million; Switzerland, $11 million.

• **New commercial** passenger transports over 3,000 lb. and under 30,000 lb., $6 million. Major importers: Canada, $2.9 million; Brazil, $542,000; West Germany, $483,000; Mexico, $335,000; Japan, $334,000.

• **New commercial** and civilian aircraft under 3,000 lb., $11.3 million. Major importers: Canada, $2 million; Mexico, $1.1 million; Argentina, $1 million; Australia, $820,000; United Kingdom, $608,000; Brazil, $589,000.

• **Used commercial** and civilian aircraft over 3,000 lb., $10.6 million. Major importers: Mexico, $4.4 million; Venezuela, $660,000; Switzerland, $592,000; Iceland, $500,000.

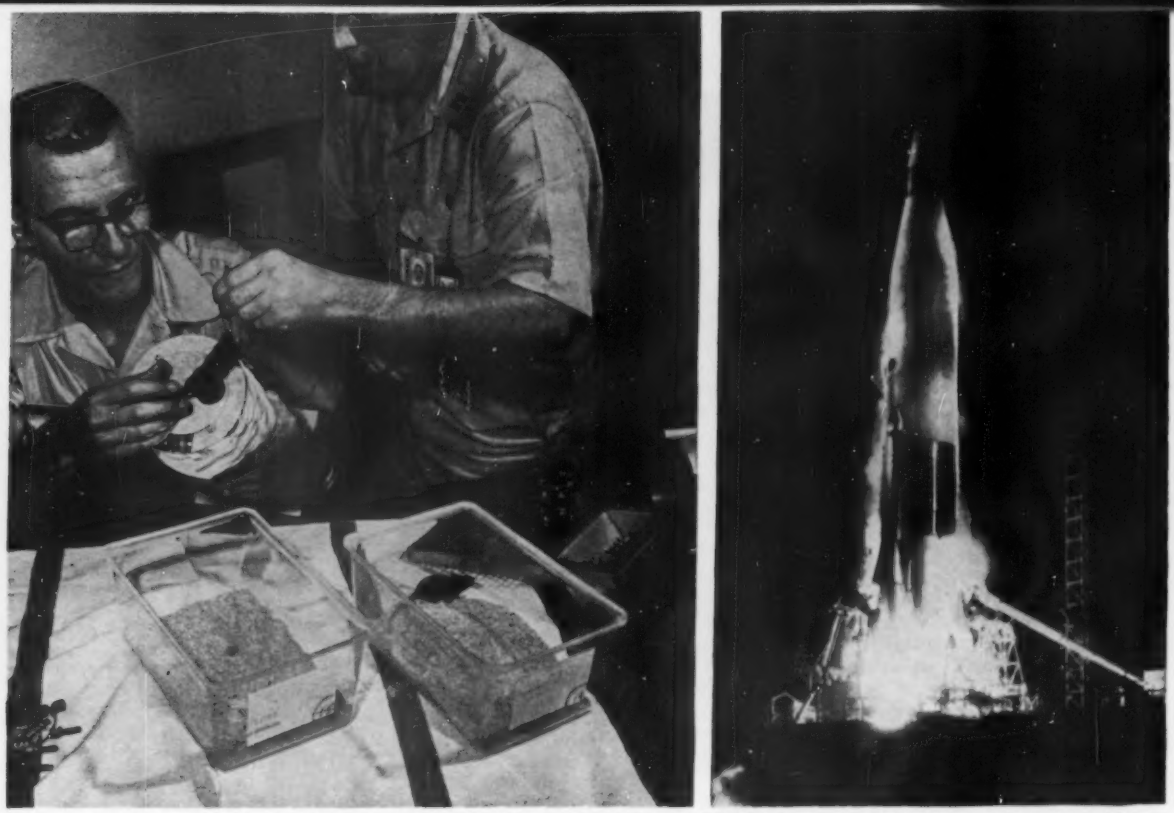
• **Used commercial** and civilian aircraft under 3,000 lb., $1.6 million. Major importers: Canada, $393,000; Mexico, $231,000; Australia, $185,000; United Kingdom, $122,000.

• **New commercial** rotary wing aircraft over 3,000 lb., $988,000. Major importers: Japan, $500,000; West Germany, $488,000.

• **New commercial** rotary wing aircraft under 3,000 lb., $2.4 million. Major importers: Brazil, $765,000; Canada, $733,000; Chile, $224,000.

The $13 million in engine exports during the first half of the year—all reciprocating types—was divided $8 million for new engines and $5 million for used engines.

The large volume of aircraft and engine parts exported included $1.6 million for propellers and $4.6 million for propeller parts. It also included $13.3 million for aircraft flight instruments and $4.2 million for aircraft landing gear and parts.



ONE OF THREE black mice is placed in a 16-in. life cell (left) for installation in RVX-2A re-entry vehicle, shown at launch (right).

USAF, Industry Study RVX-2A Results

Washington—Air Force and industry began detailed analysis last week of engineering and biomedical experiments, including three black mice, carried on RVX-2A, the 12th in a series of re-entry nose cone flights designed to evaluate ablation materials.

One flight remains in the USAF-General Electric Avco RVX-2A program to test new GE-reinforced plastic and Avco silicon dioxide ablation materials (AW July 18, p. 55). The project, which began 16 months ago, has included launch of six RVX-1 vehicles as Thor Able payloads, three RVX-2 Atlas payloads and three RVX-2A nose cones, also launched by Atlas. Avco Avcoite was used on RVX-1 cones, and materials of the two firms have been alternated in subsequent tests.

Aluminum structures for the RVX cones were built by GE, and when Avco materials are used, the structure is sent to Avco for application of silicon dioxide ablative material. As systems integrator, GE installs experiments and conducts compatability checkout.

Six of the 12 vehicles have attained the desired trajectory, and four have been recovered, including two RVX-1s and one each of the RVX-2 and RVX-2A nose cones.

Mice were carried in the 600-lb. instrument package launched Oct. 13 (AW Oct. 17, p. 29) as one of several experiments to measure radiation effects and to determine the effects of weightlessness. School of Aerospace Medicine said last week the mouse experiment was highly successful, and additional observation is planned to determine radiation effects on their offspring. Black mice were selected to learn if their fur turns white from heavy cosmic radiation dosage. Trajectory took the cone through the fringes of the lower Van Allen radiation belt.

The recovered RVX-2A, weighing about 2,800 lb., carried GE ablation resin. Cone is 146.8 in. long with a base diameter of 63.6 in. Telemetry indicated the re-entry vehicle traveled to 650-mi. altitude and about 5,000 mi. downrange in a flight lasting about 30 min. The cone was tracked 17 min., and gravity force of approximately 20g was encountered on re-entry. Nose cone has been returned to GE's Missile and Space Vehicle Department.

Other experiments carried in the cone included USAF Special Weapons Center radiation absorption measurement; emulsion packs for University of California and National Aeronautics and Space Administration; Los Alamos Scientific Laboratory proton measurement emulsion pack; plasma sheath antenna tests by USAF Wright Air Development Division, Ohio State University and GE; experimental space power tests by Space Technology Laboratories and GE, and an ultraviolet background measurement pack, designed by WADD and Armour Research Foundation.

Fuel cell and a magnetohydrodynamics generator were used in the space power experiments. Fuel cell, producing electricity by oxidizing hydrogen and oxygen, regenerates itself by electrolysis of the water back to original elements. Magnetohydrodynamics experiment consisted of magnetic coil through which hot gas generated during re-entry was passed to set up an electric field.

Emulsion packs were designed to measure flux and energy distributions of protons and electrons in the lower Van Allen belt, and to map sharp changes in energy characteristics.

Recovery sequence used a system designed and fabricated by Cook Electric Co. It consisted of a 26-ft. fist ribbon parachute, which deployed at 8,000-ft. altitude, and a 30-in. flotation bag which inflated when the cone sank to a 60-ft. depth.

Recovery aids used were a sofar bomb, radar chaff, RF beacon, strobe light and dye marker. Beacon and strobe are activated by salt water switch, turned on when the cone strikes the water.

Five Ranger Spacecraft Flights Planned

By Edward H. Kolcum

Washington—National Aeronautics and Space Administration's Ranger spacecraft program now includes three lunar impact packages, a solar satellite and an earth satellite whose highly elliptical orbit will carry it more than 600,000 mi. into cislunar space.

All five flights will be launched by Atlas-Agena B vehicles. The Ranger I earth satellite and the Ranger II solar satellite flights will have the combined missions of checking out the spacecraft system and collecting scientific information.

Rangers III, IV and V will contain 57-lb. survival packages encased in balsa wood for semi-hard landings on the moon.

Details of Ranger test objectives and instrumentation were given last week by Dr. A. R. Hibbs of the Jet Propulsion Laboratory in a lecture at the University of Maryland's Space Research and Technology Institute.

Hibbs, who heads JPL's Space Sciences Division, explained the sophisticated orientation system that will provide three-axis stabilization for the 800-lb. spacecraft in all five flights.

Ranger Flight Plans

Ranger I will be programed on a highly elliptical earth orbit with an apogee of 620,000 mi. and a perigee just outside the earth's atmosphere. Ranger II, with an identical payload, will be launched on an escape trajectory.

All three lunar packages will contain identical instrumentation.

Instruments in Rangers I and II, Hibbs said, will measure solar plasmas, using energy scales from five to 70 million electron volts. A Rubidium vapor magnetometer will measure interplanetary magnetic fields in an attempt to determine the effect of solar fields on intergalactic particles.

Ranger II's aphelion and perihelion will put it parallel to but outside the earth's orbit around the sun.

Orientation system for the spacecraft will be given component tests in the Ranger I and II flights. Complex orientation sequence begins with the jettisoning of the Agena nose fairing, either by breaking it away at the center or by projecting it ahead. Large surfaces covered with solar cells spring out like wings, and the spacecraft tumbles end-over-end until its solar sensor homes on the sun. When the craft is solar-oriented, a four-foot parabolic antenna springs out. The spacecraft then rotates until the infrared sensitive omnidirectional antenna homes on 960 mc. signals beamed from stations on earth. With solar cell housings extended, the spacecraft will be 14 ft. wide and 68 in. long.

Lunar spacecraft will include two sections—the survival package and a retrorocket pack. Trajectory for lunar impact is refined in flight on the basis of spacecraft-earth and spacecraft-sun lines, using the antenna and sun sensor as in the earlier missions. Ranger will be stabilized by nitrogen jets. Midcourse guidance depends on attitude positioning with respect to the reference lines. Midcourse trajectory corrections will be made by firing hydrazine monopropellant engines when the vehicle is about 10,000 mi. from the surface of the moon.

As the spacecraft approaches the moon—at about 200-mi. altitude—a radar altimeter will actuate a real time vidicon scanner which will transmit one picture every 10 sec., scanning 200 lines per picture. First picture will show an area of the moon 40 mi. on a side, and the last will be 2,000 yd. on a side. Two-second lapse between picture transmissions will be used for telemetering surface composition measurements from a gamma ray spectrometer.

After final video picture is sent from 80,000 ft. altitude, the spacecraft will spin up and the section housing the TV camera and spectrometer will be jettisoned. Retrorocket will fire at 70,000 ft. to reduce velocity from 8,000 fps. to a maximum of 500 fps. Hibbs said the nominal impact will be 110 fps.

Purpose of the midcourse correction in Ranger flights, Hibbs said, is to place the spacecraft on a straight-in trajectory so that there will be no sidewise velocity on impact. Seismometers surrounded with crushable balsa for shock attenuation have been dropped from 2,000-3,000 ft. altitudes to determine survivability, and they have not been affected by 500 fps. impact loads, Hibbs said.

Survival Package

Survival package will include a seismometer, two thermometers, two accelerometers, power supply—probably mercury batteries—a transmitter and amplifier, directional antenna, and temperature control device.

Gamma ray spectrometer will be used to determine presence of potassium, thorium and uranium elements on the moon's surface.

Ranger I is expected to have a short life, with perhaps only one or two periods, each lasting two months. Attitude control system is expected to function for only 60-100 days, Hibbs said, and rate gyro system of the type to be used usually lasts about the same time.

Both Rangers I and II are designed specifically to look for neutral hydrogen clouds at the fringes of the earth's upper atmosphere. Hibbs said if this gas is extremely hot, the hydrogen envelope surrounding the earth will extend out several hundred thousand miles. If it is relatively cool, the envelope tends to collapse around the earth.

Ranger spacecraft will utilize the deep space tracking network now being established by NASA. This includes stations at JPL's Goldstone facility in California, one in South Africa and one in Australia.

Contract Overcharges Reported to Congress

Washington—General Accounting Office has told Congress that Philco Corp. overcharged the Navy $218,200 on an incentive contract for Sidewinder missile guidance and control units.

GAO said that the target price negotiated for the contract was excessive by $589,600 because the cost of materials for channel ring and wing assemblies, plus related costs, was included even though it had been agreed by Navy and Philco that these assemblies were not to be furnished under the contract. Under the incentive provisions of the contract this resulted in "unnecessary cost" to the government of $218,200, according to GAO.

Navy is reviewing the case.

Philco maintained that the cost of the channel rings and wings was eliminated from its estimate, but that its proposed price was not reduced in order to provide for the contingency of possible increases in the cost of material.

GAO charged that Navy contracting officials "relied on Philco's statements that the cost of these items had been excluded from its proposal" and did not conduct an adequate review of the contract.

Convair and Thiokol Chemical Corp. voluntarily returned $135,000 to the Air Force on Atlas ICBM booster valve contracts after the General Accounting Office reported overpricing.

On subcontracts totaling $511,400, GAO claimed an overcharge of $103,500. Reaction Motors Division of Thiokol refunded $87,800 on these subcontracts, plus $47,200 on other subcontracts which GAO did not examine. Convair passed the refunds on to the Air Force.

Ground Equipment Costs Show Steady Rise

Los Angeles, Calif.—Cost of ground support equipment, now called aerospace ground equipment (AGE), is rising at such a rate that it will soon dictate whether or not a weapon system development should be produced, Maj. Gen. Austin Davis, director of procurement and production for Air Materiel Command, told the National Aeronautic Meeting of the Society of Automotive Engineers here.

Gen. Davis and panel chairman L. B. Barlow of Boeing Airplane Co. cited figures to show the rising proportion of ground equipment cost to the cost of the total system. Between 1960 and 1970, Barlow said:

- **Total procurement** of air and space systems will rise from $11 billion to $16 billion.
- **Total expenditure** on AGE will rise from $2 billion to $4.8 billion or from 18% to 30% of the total value of the system.

AGE Costs

Gen. Davis said that the cost of ground equipment for a Boeing B-52 wing is about $18 million, and for a Convair B-58 it is about $30 million. The number of ground equipment items peculiar to a type of fighter aircraft shows a steady rise. Some of the individual items cost as much as $900,000. The number of AGE items per squadron is:

- **North American F-100**—500 items.
- **Convair F-102**—700 items.
- **Republic F-105**—950 items.
- **Convair F-106**—3,200 items.

In other discussions, a controversy developed over the effects of military specifications, standards and handbooks upon costs. Particularly controversial is Mil-D-9412, covering the data to be supplied to USAF for monitoring the progress of a program. An official of one large company said privately that Mil-D-9412 makes contractors turn out 50% more administrative paper than would otherwise be necessary. He said the engineering hours spent on administration amounts to as much as 40% of the total engineering hours spent on a project. It should be possible to cut the figure to 20%, he contended.

Gen. Davis charged that industry has tried to evade the requirements of the specification and thereby caused confusion that has boosted costs and delayed schedules. He noted that Lt. Gen. Bernard A. Schriever has said that Mil-D-9412 will be applied to all future Air Force weapon systems. Barlow pointed out that USAF has taken over systems management from industry and that the company-designated systems manager acts mainly as liaison between the various contractors and USAF.

Industry opposition to the specification has led USAF to seek a more acceptable version and a draft is being circulated to companies for comment. It is scheduled for release Nov. 2.

Cost Responsibility

Engineers also have assigned much of the blame for high costs to military specifications covering design and manufacturing, but Barlow disagreed. He said engineers have used inappropriate specifications and standards for their design parameters because it was easier. He said when thorough engineering does not square with specifications and standards, permission to deviate from the latter can usually be obtained from the Air Force in a few hours and will save thousands of hours of "gold plating."

He noted that many engineers now designing ground equipment once designed aircraft. He warned supervisory engineers to prevent aircraft military specifications and aircraft quality production and inspection standards from creeping into mechanical ground support equipment, which often can be rough structures.

Second-Generation Dyna-Soar Vehicle

Los Angeles, Calif.—Winged, manned vehicle which will go from earth into orbit and return under its own power is under study by Air Force as a follow-on for the USAF-Boeing Dyna-Soar, Lt. Gen. Roscoe C. Wilson, deputy chief of staff-development, told the Society of Automotive Engineers here.

This one-stage-to-orbit vehicle would use aerodynamic lift while rising through and re-entering the atmosphere. "Such a vehicle," Gen. Wilson said, "would be able to take off and land conventionally and combine many of the advantages of a rocket booster and an aircraft. From our investigations, this concept of a future aerospace vehicle appears feasible, but a research and development effort over a considerable number of years is necessary to bring this craft to reality."

The spacecraft under study would draw upon the experience gained from Dyna-Soar for solution to manned space flight problems. Also, the knowledge and training Dyna-Soar pilots must possess runs the gamut of aeronautical and astronautical arts and "we must begin training these pilots within the next year. We expect to be flying Dyna-Soar itself within the next three years," Wilson predicted.

Gen. Davis asked industry to practice "value engineering" more extensively to get a better correlation between talent and money expended and the usefulness of the end item. He said USAF would prefer to make it a regular contractual requirement.

Wes Peters of Four Wheel Drive Corp. asked for a freer interchange of knowledge to save the cost of re-inventing problem solutions already discovered elsewhere. He said the necessity of establishing a need-to-know slows and discourages the exchange of information.

Maj. Benjamin N. Bellis, of Air Force Ballistic Missile Division, criticized industry for making an excuse for failure of the practice of concurrent work on the various phases of development and production in the ballistic missile program. He said that since the practice is necessary, it cannot be used as an excuse. Bellis said that if careless practices cause a one week slippage at each of the operational missile bases, the cost will add up to $20 million.

In another discussion, high altitude starting capability of the Rocketdyne H-1 engine for use in Saturn was detailed by W. F. Ezell, North American Aviation project engineer for advanced engine systems. Without modification or the use of auxiliary devices, Ezell said that the engines had been started at representative altitudes above 105,000 ft. in a series of tests conducted in a special high altitude simulation cell at Arnold Engineering Development Center, Tullahoma, Tenn. The altitude start capability was established analytically and by 17 demonstrations in the altitude cell.

Engine Start

Starting method of the Saturn engines was outlined in another report by Roy Healy, also of Rocketdyne. The previously used two ground starting tanks, with their complex fill, vent, and level sensing devices, pressurization system, and quick disconnects, have been replaced by a simple cartridge starter bolted to the engine. The complex thrust level control system used in the Jupiter engine, consisting of pressure transducer, magnetic amplifier, hydraulic servo valve, gas generator liquid oxygen throttling valve, bleeds, etc., has ben replaced by simple calibrated orifices.

Pressure from the fuel pump discharge, rising as the pumps are spun up by the cartridge starter, is used to open valves automatically in proper sequential relationship. Similarly, pressure decay after the cutoff signal has been given permits the spring-loaded valves

to close in proper relationship. This pressure-controlled sequence permits elimination of the previously used event-sensing electromechanical devices, including microswitches on valves, relays, solenoid valves which controlled pneumatic pressure to open or close valves, burn-through links used with pyrotechnic devices to ignite the gas generator and thrust chamber propellants, and a burn-through link at the chamber exit which signaled that the ignition flame was satisfactory. The electrical system for engine control has been reduced to approximately 5% of that employed on previous engines. The engine pneumatic requirements have been reduced to a similar low value.

Once fuel arrives at the injector, thrust buildup is rapid, averaging 60,000 lb. per 10 milliseconds. The H-1 reaches main stage operation rapidly, producing the "cannon-ball" start with its distinctive acoustic shock.

An advanced model of the engine known as the H-2, Healy said, may utilize a direct-drive turbopump and eliminate the complete gas generator system by employing gases bled off the main thrust chamber to power the turbine. In approximately the same physical envelope and of almost the same weight as the H-1, the H-2 is intended to develop 250-300,000 lb. of thrust. This would raise the total thrust of the light-engine cluster to 2-2.4 million lb.

STOL Developments

A panel headed by C. W. Harper, of National Aeronautics and Space Administration's Ames Research Center, reviewed the progress to date in V/STOL aircraft. Col. Robert Williams, chief of the Air Mobility Division, U. S. Army, said, "the entire problem has been reviewed and committed to death in the last two years. We've built a whole series of test vehicles in the last 10 years and although everyone says we've made progress, they still say we have problems."

Col. Williams urged that an operational research type V/STOL aircraft be built so that the unknowns in the problem can be worked out. "Unless we build such a vehicle and decide on which approach—tilt wing, deflected slipstream, lift fan, tilt-duct, etc.—we will slide downhill."

V/STOL problems were enumerated by Charles Zimmerman, of NASA's Langley Research Center, as being:

• **Downwash.** VTOL turbojet-powered aircraft have caused considerable damage to takeoff and landing areas by digging holes in such surfaces. Recirculation of objects borne by the downwash also is a problem which probably will always remain. Damages to ground objects is another problem and is directly related to the gross weight of the aircraft. No matter which lifting and propulsion methods are used, downwash damage still is in direct proportion to the size of the vehicle.

• **All-weather operation.** Helicopters, which have been operating in increasing numbers since the end of World War II, still do not have all-weather operating capability.

• **Component weight.** Little is left for payload in the V/STOL aircraft because of the weight of components, particularly gearing between the power source and the lifting mechanism.

• **Cost.** Reduction in initial cost as well as maintenance cost will have to be made if the V/STOL aircraft is to be successful.

Zimmerman said the weight breakdown of a typical VTOL transport is: structure and equipment, 45%; propulsion, 22%; fuel, 21%, and payload, 12%.

ICBM Defense Group

Washington—Special technical advisory group for ballistic missile defense, with representatives from four laboratories involved in ICBM defense research under Advanced Research Projects Agency contract, has been formed to advise ARPA's assistant director for ballistic missile defense, Albert M. Rubenstein. The four laboratories are: Cornell Aeronautical Laboratory, Massachusetts Institute of Technology's Lincoln Laboratory, Stanford Research Institute and University of Michigan's Willow Run Laboratory. The new technical advisory group will review, evaluate and make recommendations on various aspects of the ballistic missile defense problem with which its member laboratories are concerned.

Nixon Promises Bigger U.S. Defense Effort

Miami Beach—Vice President Richard M. Nixon repeated his contention that the U.S. is the strongest military power in the world but also promised a bigger defense effort in a speech to the American Legion convention.

On the defense issue, Nixon said that whatever political opinion there may be of U.S. strength today, "I happen to know and Mr. Khrushchev knows, that we're the strongest nation in the world and we're going to continue to stay that way.

"But, whatever we may think of our strength today, America can never stand pat on that strength because we are confronted by an enemy—ruthless, fanatical—and as that enemy is dedicated to conquering the world by any means, including the use of force, and he constantly steps up his preparedness in order to use that force to extend power throughout the world, it is essential that America increase its strength."

The Republican presidential candidate said that he didn't have any doubt that the public will support the necessary steps—"and there will be necessary steps"—which will increase America's strength. He said that the U. S. defense effort will have to be increased to take advantage of new technological breakthroughs and to make the U.S. deterrent force "absolute and unattackable." He favors increased effort to make sure the U.S. "whether it's a small war or a big war, will have the ultimate power that no one—Mr. Khrushchev, Mr. Mao Tse-Tung or any other enemy of peace—will dare start anything against the United States."

GE Strike Weakened As Top Local Returns

Washington—International Union of Electrical Workers' strike against General Electric was seriously weakened last week when the union's largest GE local broke ranks and returned to work at the company's Schenectady, N. Y. plant.

IUE President James B. Carey bitterly denounced the Schenectady local's action and began an intensive effort to block similiar defections by several other large locals whose support of the strike has been lukewarm. Shortly afterward, the federal mediator announced that negotiations had been suspended indefinitely following a company statement that an impasse had been reached.

GE reported that nearly 40% of the factory workers were reporting for duty at its Syracuse, N. Y. Electronics Division, despite picket lines. This division produces military radar and systems. The company said that 95% of its factory employes are at work in plants at Burlington, Vt. and Bridgeport, Conn., where locals are still officially on strike.

Announcing the Schenectady local's decision to return to work, Leo Jandreau, who has been the local's business agent for 20 years, sharply criticized Carey for launching "a fight to the end with GE, regardless of the consequences." Carey termed Jandreau a "Judas" and a "Quisling." Jandreau was an active supporter of the last major strike against GE in 1946. The local returned under the terms of the old contract except for deletion of the cost-of-living escalator clause.

At Westinghouse Electric, where IUE is negotiating a new contract, the union voted to extend the previous contract a week to permit continued negotiation, but it was scheduled to take a strike vote late last week.

At midweek an IUE official indicated that the union had modified earlier demands in an effort to reach agreement with Westinghouse.

Nuclear Plane Will Fly for Five Days

Ft. Worth, Tex.—First U.S. nuclear-powered airplane, which, the Air Force has indicated, will fly in 1965, will probably have a speed of Mach 0.8-0.9 at 35,000 ft. and have an endurance of approximately five days, a scientist working on USAF design studies for the ANP-NX2 nuclear-powered testbed here at Convair's Ft. Worth Division disclosed last week. It was pointed out that the airplane could operate at altitude or at tree-top level with no loss of endurance.

The testbed, which will possess some useful payload capability, will probably closely resemble the configurations depicted in AVIATION WEEK Aug. 15, p. 132, which are being developed to use the Pratt & Whitney Aircraft indirect-cycle and General Electric direct cycle nuclear turbojets. These provide capability of takeoff and climb using chemical fuels and switchover to nuclear power for the main portion of the mission.

Airframe will utilize conventional state-of-the-art materials, and because of the aircraft's endurance capability, equipment must be long-lived, having at least 1,000 hr. time between overhaul or replacement.

Indications are that the ANP-NX2 nuclear-powered testbed will incorporate no major breakthroughs in shielding materials; rather it will utilize steady-state progress in research conducted here in Convair-Ft. Worth's nuclear aircraft reactor facility and other research laboratories.

Researchers at the Convair facility here, which has been engaged in nuclear-powered aircraft problems since 1951, say that shielding does not represent the major problem in building such an aircraft. The company is currently operating two "homebuilt" 3,000 kw. reactors here, one for studying the effects of radiation on aircraft equipment, such as navigation and communications equipment, actuators, and materials, including lubrication and hydraulic fluids. The other reactor is being utilized to study shielding configurations for crew compartments. It is currently arranged so that a mocked-up crew compartment is located the same distance from the reactor as one would be in the ANP-NX2 design under study here, with varied shielding materials and configurations emplaced by remote control around the crew compartment mockup. Studies are providing data on quality of gamma and neutron emission effects on crew compartment shielding.

Aircraft configuration provides completely clear area in the aft fuselage for ready access to the engine compartment, which will be so designed that powerplants will embody modular concept for ease of remotely controlled connect and disconnect. Vertical fins are emplaced on the wingtips to maintain clear fuselage aft area. Canard configuration is utilized to provide adequate control moments bearing in mind that the divided shielding concept will place considerable weight in the nose portion of the aircraft housing the crew, as well as in the aft fuselage in the engine area.

Apollo Bids Submitted By 14 Companies

Washington—Fourteen companies have submitted proposals for $250,000, six-month feasibility studies of the Project Apollo multi-man spacecraft system, which National Aeronautics and Space Administration plans to award Nov. 14.

Companies submitting proposals were Aero-Space Division of Boeing Airplane Co.; Astronautics Division of Chance Vought Aircraft; Convair Division of General Dynamics Corp.; Cornell Aeronautical Laboratory, Inc.; Douglas Aircraft Co.; General Electric Missile and Space Vehicle Dept.; Goodyear Aircraft Corp.; Grumman Aircraft Engineering Corp.; Guardite Space Technology Division of American-Marietta Co.; Lockheed Missiles and Space Division; Martin Co.; McDonnell Aircraft Corp.; North American Aviation, and Republic.

Vought Named Prime For Scout Vehicle

Dallas—Chance Vought Aircraft became prime contractor for the Scout launch vehicle system last week under a $6 million contract awarded by National Aeronautics and Space Administration. The company will assemble and launch at least 52 vehicles over the next nine years.

Guidance and control units and rocket motors will be shipped to Chance Vought's Dallas plant for assembly and mating with airframes and motor transition sections. Completed Scouts will then be shipped to NASA's Wallops Island, Va., station for launching. Previously, assembly and launching were handled by NASA at its Langley Research Center, with Vought's help.

TWA Financing Delay

Trans World Airlines financing still was not completely settled last week. Although TWA owner Howard Hughes has accepted in principle that his stock be placed in a voting trust (AW Oct. 17, p. 41) he specified some conditions to be met by the financing group in return and these are causing further delay.

News Digest

Los Alamos Scientific Laboratory conducted a successful power run of the Kiwi-A3 reactor in the Rover program last week at its Nevada test site. Reactor appeared to conform to design specifications. Power run was similar to those conducted with Kiwi-A and Kiwi-A Prime reactors. Modification of Kiwi test cell is planned to permit use of liquid hydrogen as the propellant.

Submarine USS Patrick Henry last week successfully fired four tactically configured Polaris missiles under operational conditions in the Atlantic Ocean 500 mi. east of Cape Canaveral, Fla.

Atomic Energy Commission is testing at its Los Alamos, N. M., site a filter designed to detect nuclear explosions in near space from ground stations as a part of Project Vela.

Chance Vought pilot escape capsule model (AW Sept. 19, p. 123) was successfully tested and recovered last week after being fired to a velocity of Mach 1.3 by a British Gosling rocket from Wallops Station, Va.

Atlantic Research Corp. Iris sounding rocket carried a 125 lb. payload to an altitude of 140 mi. last week in a qualification program launch from Wallops Island, Va.

Wavelength of light has replaced a meter bar as the new international standard of length. The 11th General Conference on Weights and Measures decided last week to define the meter as 1,650,763.73 wavelengths of the orange-red line of krypton 86.

Clauser Technology Corp., Torrance, Calif., has been formed for research and development in fields of advanced technology, including thin film semiconductivity, micro-circuitry, cryogenic pumping for space simulation chambers, plasma propulsion, and quantum electronics. Dr. Milton U. Clauser is president.

Boeing Airplane Co. has selected American Car & Foundry Division of ACF Industries, Inc., to design, develop and manufacture two prototype power generating cars for Air Force's Minuteman ICBM trains.

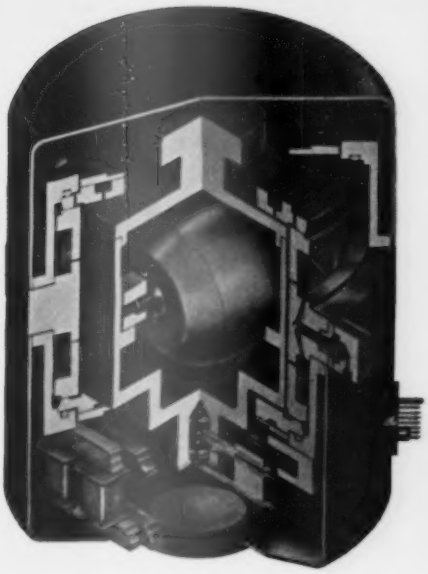
Atlas ICBM was destroyed by a Strategic Air Command crew 1 min. after night launching from Vandenburg AFB.

U. S. Navy has awarded Lockheed Missiles and Space Division a $181 million contract to develop an advanced 1,500 mi. version of Polaris submarine missile. Hercules Powder will build the second stage engine; Aerojet-General, the first stage.

from Belock's Astro-Space team...

GAS BEARING GYROS

that guided the first satellite of the Western World into orbit



Now available for navigation, stabilization and control—rugged and reliable gas bearing, floated and magnetic gyros are being designed and produced at Astro-Space Laboratories, Inc. under Dr. Frederick K. Mueller and the same scientific team that made American missile history. The gas bearing gyros feature a single axis of freedom (externally pressurized) with angular momentum from 100,000 gr cm^2/sec to 50,000,000 with 1" to 4" wheel diameters.

ASTRO-SPACE LABORATORIES, Inc. HUNTSVILLE, ALABAMA

a subsidiary of BELOCK INSTRUMENT CORPORATION

TITAN—*50 miles up: Official USAF Photo*

Air Force-Martin Titan, *giant American ICBM, has been chosen for a key role in space exploration. One of its first missions will be to launch USAF Dyna-Soar — manned aerospace craft.*

MARTIN

Speed Limits Raise Electra Operating Costs

Direct expenses per total aircraft mile increase but passenger load factors hold up fairly well.

New York—Costs of operating the Lockheed Electra turboprop transport have climbed since Federal Aviation Agency imposed a restriction on Electras operated by U. S. carriers.

Direct expenses per total aircraft mile averaged 103.67 cents for six airlines in the last quarter of 1959; the average was 153.87 cents in the second quarter of 1960.

Passenger load factors in Electra operation, however, have been holding up fairly well despite a series of accidents and the attendant rash of adverse publicity.

The pattern apparently has involved a load factor dip following an accident, then a climb back to nearer normal loads.

Load Factors

A comparison of Electra load factors before and after the restrictions shows an average drop of only 2.4% among the six operators.

For the 1959 fourth quarter, the load factor averaged 58.4%; during the second quarter of this year, the average was 56%.

This comparison is not precise. Load factors normally look better in the second quarter period than in a fourth quarter, when traffic is at a slower level of activity. For all types of aircraft, the same six airlines' average load factor rose 2.73%, up from 55.25% in the 1959 period to 57.98% in the 1960 period.

Another element affecting Electra load factors is the shifting of the turboprops to secondary routes as jets take over many high-frequency segments.

The Oct. 4 crash of an Eastern Air Lines Electra into Boston Harbor (AW Oct. 10, p. 37)—fifth serious accident involving the plane—has not had a great permanent effect on loads, according to the airlines. It may be too early to spot a firm trend, but Eastern said its system bookings on Electras have been increasing again after a 21% drop on the second day after the accident. Other carriers report little discernible effect on Electra load factors.

Publicity Problem

Publicity resulting from the Electra crashes and demands that the airplane be grounded pose a serious problem for its future, most operators agree. However, domestic operators surveyed by Aviation Week expressed confidence that this problem would be overcome. It was pointed out that the Electra's reputation is at least partly undeserved, since it has been shown that there were causative similarities in only two of the accidents.

Lockheed's modification program (AW Aug. 1, p. 37), is now under way with six of the Electras fully converted. At least two Electras owned by Lockheed are being introduced into the flight and static test programs being conducted by Lockheed in cooperation with the National Aeronautics and Space Administration and the Federal Aviation Agency. Results of these tests will determine whether modifications or fixes meet FAA certification standards required to warrant removal of the speed restrictions now imposed on the aircraft.

Operationally, the Electra has presented a number of problems since its introduction less than two years ago. Early Electras in service developed a vibration problem that required an extensive field program of modifying and retrofitting to tilt the engines and raise the engine thrust line. Propeller synchro-phasing also was modified in this program.

Another modification was made to correct wing skin cracking problems by installation of reinforcing aluminum plates.

Electras in airline service are rapidly moving to short-haul and multi-stop routes as jets take over the prime segments. The two largest Electra operators—American Airlines and Eastern Air Lines—point out that this kind of service was what they intended for the Electra and they foresee a long and useful service for the airplane in this role.

Braniff International Airways, on the other hand—with a different type of route structure—is thinking in terms of short-range jets and has decided to buy no more turboprops of any kind.

Carriers' Reports

Here is a report from each of six carriers on its Electra outlook:

• **American** says the costs of operating its Electra have been oscillating. In the fourth quarter of 1959, after about a year of service, American's direct expense per total aircraft mile was reported as 123.91 cents. In the second quarter of 1960, this cost had climbed to 157.39 cents. The restrictions have had an effect on costs, but were not the only factor, in American's view.

A big item has been the unusual inspections required by Federal Aviation Agency as safety precautions following the accidents. Example: an order to inspect all wing clips. There are 2,700 clips on each wing and this inspection caused a loss of 16 airplane hours for each Electra. The Allison engine has not shown the reliability of the jet engines in American's fleet, the airline said, and premature removals have been fairly numerous.

Even in the fourth quarter of 1959,

ATA CATEGORY	1959 ATA	RATE PER 1000 DEPARTURES 1960 WEIGHTED AVERAGES JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
21 - AIR CONDITIONING	3.7	4.4	4.7	2.8	2.7	3.3	4.0	2.4	3.2
24 - ELECTRICAL	8.3	4.6	4.1	3.3	2.7	3.3	2.5	2.4	3.2
30 - ICE & RAIN PROTECTION	NA	2.1	3.1	2.4	1.5	2.3	1.2	1.2	1.8
32 - LANDING GEAR	NA	3.9	3.6	4.8	3.4	4.1	3.8	3.4	3.9
34 - NAVIGATION	4.9	4.7	4.3	6.2	4.4	4.2	4.5	4.1	3.9
52 - DOORS	2.3	3.5	4.0	3.7	2.7	3.0	3.0	2.1	2.2
61 - PROPELLERS	8.1	6.0	6.4	7.2	5.7	6.0	5.0	5.5	3.7
72 - ENGINE	5.5	8.3	6.5	9.1	7.0	7.4	6.2	7.0	5.0
77 - ENGINE INDICATING	NA	4.4	3.6	4.0	3.9	3.5	3.7	3.5	3.0
80 - START SYSTEM	9.0	6.6	6.7	4.0	4.3	4.2	3.7	2.5	3.3
TOTAL (ABOVE CAUSES)	36.3	48.5	47.0	47.5	38.3	41.3	37.6	34.1	33.2
OTHER DELAY CAUSES (REMAINING ATA CATEGORIES)	54.7*	18.4	13.7	22.0	16.6	16.6	10.7	9.3	9.7
GRAND TOTAL MECH. DELAYS PER 1000 DEPARTURES	91.0	66.9	60.7	69.5	54.9	57.9	48.3	43.4	42.9

DELAYS are broken down in Lockheed chart to show top 10 causes.

Lockheed Electra Operations

Passenger Load Factors (%)
All Scheduled Services

Airline	Fourth Quarter 1959	Second Quarter 1960	Increase or (Decrease)
American	72.3	60.0	(12.3)
Braniff	51.9	49.1	(2.8)
Eastern	52.7	54.5	1.8
National	48.8	56.3	7.5
Northwest	63.6	55.3	(8.3)
Western	70.3	51.9	(18.4)
Average	58.4	56.0	(2.4)

Total Direct Expense
Cents per Total Aircraft Mile

Airline	Fourth Quarter 1959	Second Quarter 1960	Increase
American	123.91	157.39	33.48
Braniff	111.25	158.55	47.30
Eastern	92.33	153.03	60.70
National	111.54	160.22	48.68
Northwest	78.77	120.46	41.69
Western	124.85	176.20	51.35
Average	103.67	153.87	50.20

Selected Operating and Financial Data On Six* Electra Operators

	Fourth Quarter 1959	Second Quarter 1960	Increase or (Decrease)
Passenger Load Factors%			
First Class	57 4	54 1	(3 3)
Coach	61 9	62 6	0 7
Average	58 4	56 0	(2 4)
Average Passenger Load	41 2	39 8	(1 4)
Off-On Speed (mph.)	333 4	281 6	(51 8)
Fuel Consumption (gph.)	774	664	(110)
Direct Operating Expenses—			
Dollars per Total Hour:			
Flying Operations			
Crew Expense	57 85	86 28	28 43
Fuel, Oil & Taxes	75 81	67 91	(7 90)
Insurance	17 23	17 40	0 17
Other	0 09	0 13	0 04
Total	150 98	171 72	20 74
Direct Maintenance			
Airframes	24 01	33 89	9 88
Engines	59 90	98 01	38 11
Other Flight Equipment	15 15	15 50	0 33
Total	99 06	147 40	48 34
Depreciation and Rentals	98 24	116 37	18 13
Total Direct Expense—$/hr.	348 28	435 49	87 21
Cents per Revenue Plane Mile	108 10	158 43	50 33
Index	100 0	146 6	46 6

*American, Braniff, Eastern, National, Northwest, Western. Source: Carriers Forms 41.

Prepared by Ray and Ray

before the restrictions, costs had not been brought down anywhere near the level expected in the future. Costs in fact are difficult to pin down as yet because of several factors. One is that the schedule shifts as jets come into service, with Electras assigned to shorter routes; another is reduced utilization and cost-accounting problems under American's engine-leasing agreement. Settlement under the leasing agreement is subject to yearly review, but the final figures are not arrived at until several months after the period; meanwhile, results by quarter do not show proper accrual among the quarters of the year under review.

Jet Frequencies

American's Electras are rapidly being withdrawn from routes taken over by jets. For example, Boeing 720 medium range jets will enter service Oct. 30 on American's New York-Toronto, Los Angeles-Phoenix, New York-St. Louis, and New York-Detroit routes. Replaced Electras will be used to increase New York-Boston, New York-Washington, and Chicago-Detroit frequencies, and will replace some Douglas DC-6 piston aircraft in New York-Syracuse and New York-Rochester services.

But introduction of jets on these routes does not mean that all Electras are withdrawn from the routes. Between New York and Toronto, for example, the Oct. 30 schedules call for two jet schedules daily. Electras will still make up the balance of equipment on this high-frequency route. In other words, as jets are phased into new routes, Electras will still be called upon for some time in the future to complete the service pattern over many segments.

Eventually, in American's plans, the turboprops will take over almost all of the short and multi-stop routes Convairs and DC-6s were flying a few years ago.

American's Letter

As an example of American's efforts to overcome the publicity problem with the Electra, the airline recently sent a letter defending the aircraft, over the signature of C. R. Smith, president, to its Admiral's Club customers. This letter lays American's reputation on the line in expressing the firm conviction that the Electra is safe and that there is no good reason why it should be grounded.

• **Braniff reports an increase** of 30-31% in operating costs of the Electra for the four months following imposition of the restrictions as compared with the previous four months. This includes direct operating costs plus maintenance and depreciation allowances. Regarding load factors, Braniff says the average fell

off five or six percentage points following each accident and took about a month to climb back to normal. Otherwise, average load factors are about the same as Braniff's fleetwide average, which covers 707s, DC-6s, DC-7Cs and Convairs. Braniff had nine Electras, lost one in the Buffalo, Tex. accident.

• **Eastern's direct expense** per total aircraft mile for the Electra averaged 153.03 cents in the second quarter of 1960, an increase of 60.7% over the fourth quarter of 1959. Eastern acknowledges that the psychological problem with the airplane regarding public acceptance will be a very important factor in the Electra's future; but believes the problem will be solved.

The airline expressed confidence in the Electra, and commented that an important aircraft type "can't be abandoned for emotional reasons." A possible approach to the problem, Eastern suggested, might be to treat the Electra as an entirely new airplane after it is modified and even to change its name.

Eastern's Douglas DC-8 jets have been replacing Electras on such prime long-haul routes as New York-Miami, New York-Puerto Rico, and New York-New Orleans. Examples of the shorter routes the turboprop is now serving are Newark to Washington via Philadelphia and Atlantic City; Atlanta-Mobile; Chicago-Atlanta-Jacksonville-Miami. It is also on high density routes such as New York-Boston and New York-Washington. In general, the Electra has replaced DC-7B and Super Constellation first class services. Longest route the Electra now flies for Eastern is New Orleans-Newark, a 1,170-mi. night coach flight which is operated primarily for aircraft positioning purposes. Eastern as of last week had carried 1,457,000 passengers in its Electras during 1960.

• **National Airlines** said the best cost comparison available for before-and-after-restriction Electra operation is the average seat mile cost of 1.6469 cents for the five months ending June 30, 1960, up from 1.2195 cents for the seven months ending Jan. 1, 1960. But, National said, there is no way to pinpoint the additional costs of the restrictions. The airline said its experience from an operations-maintenance standpoint has revealed no excessive problems with the airplane. It has not proved different in this regard from other aircraft introduced into service. National expressed "utmost confidence" in the Electra. It reported a few passenger cancellations since the Oct. 4 crash, but has concluded that any passenger reaction away from the airplane has not been significant enough to show up in its statistics. For three days of the week in which the accident occurred total passengers carried was up 3.5%; however, this coincided with the addition of coach seats which raised capacity. National has 12 Electras in its fleet and expects two additional deliveries in December. National recently has shown interest in the Sud Aviation twin-jet Caravelle and has indicated it has potential purchasers for its Electras (AW Oct. 3, p. 39).

• **Northwest Orient Airlines** reported an increase of 41.69% in direct expense to an average of 120.46 cents per total aircraft mile in second quarter, 1960, as compared with fourth quarter, 1959. Northwest has a fleet of nine Electras—a tenth was lost in the Tell City, Ind., crash—out of an original order of 18 aircraft. The airline has not decided when it will take delivery of the balance of eight Electras, or whether it positively will take delivery. As a partial substitute, it is leasing back from Douglas Aircraft Co. five DC-7s that had been turned in in connection with a DC-8 purchase. It also has been leasing three DC-7s from CMA of Mexico.

Northwest, however, says load factors have held up fairly well on its Electras and public acceptance has been reasonably good. There were a few cancellations after the Oct. 4 incident. The restrictions have significantly increased operating costs, particularly since Northwest was flying Electras on relatively long-haul segments where slower flight times have a greater effect in building up all costs. When the speed limits went into effect after the Tell City crash, Northwest took Electras off its New York-Seattle nonstop route. One reason: slowed-down cruise speeds meant the flight could not be made consistently on a nonstop basis. Northwest believes it is difficult to evaluate the Electra until it can be operated according to original specifications. The airline's modifications are scheduled to begin in January. The airline expressed "every confidence" that the Electra will prove out.

• **Western Air Lines** says the restrictions have represented a 15-20% increase in seat mile costs. An analysis of such costs in August, 1960, showed an increase of 20% over August, 1959, Western said. Utilization, however, had decreased from 8¼ hr. to 7¼ hr. During the same months, Western's DC-6Bs showed an increase of 15% in seat mile costs and a drop in utilization from 9 hr. to 8 hr. If the Electra's speed is restored, Western believes its seat mile cost will be as low as that of the DC-6B, assuming the same utilization for each plane. Load factors have declined on routes where the Electra has been competitive with jets. Generally, Western said, there have been few operational problems with the Electra and few substitutions of aircraft. On-time performance for May and June was almost 75%. Unscheduled engine removals have not been excessive, Western said. The airline expressed confidence in the Electra if it could be operated at specification speeds.

In a recent report on performance of its Electra, Lockheed noted the problems that had faced the operators, including the restriction, the unusual inspection and maintenance requirements, and the "undesirable press notoriety" resulting from the accidents.

Nevertheless, according to the report by Lockheed's R. A. Barnard, director of parts and services, flight hours have mounted at a steady pace, with a total of 375,310 hr. at the end of August with the operating Electra fleets.

Flight legs of the Electras have shortened from an average of 3.8 hr. per landing in the first quarter of 1959 to about 1.5 hr. in the past four months. There has been a corresponding increase in the average number of landings per airplane per month from 38.4 in fourth quarter 1959 to 133 landings per airplane per month in the second quarter of 1960.

Despite this increase in the frequency of takeoffs and landings, Lockheed reports, delays due to mechanical troubles have been reduced. In August, the total rate of mechanical delays was 42.9 per 1,000 departures, or about 4%, Lockheed reported. Delays caused by the air conditioning system averaged 3.65 per 1,000 departures during the first six months of 1960; average for the third quarter declined to 2.8. Electrical system-caused delays averaged 24 per 1,000 departures in early 1959, according to the report, but declined to an average of 2.8 delays during late 1959. Average daily utilization for all Electras is about 7 hr.

There are now 135 Electras in service with 13 U.S. and foreign airlines.

CSA to Resume Il-18 Service

Prague — Czechoslovak Airlines is scheduled to resume flights this week to Zurich-Rabat-Dakar-Conakry with the first of its four Ilyushin Il-18 turboprop transports grounded in August and flown back to Moscow for modifications following an Aeroflot Il-18 crash (AW Aug. 29, p. 45). Aeroflot already has begun funneling its Il-18s back into service.

The Czech airline expects delivery of the other three Il-18s shortly and will resume all normal services with this aircraft including the Baghdad via Athens and Damascus run.

According to Federal Aviation Agency Administrator Elwood Quesada, who recently visited Russia, investigations into the causes of the crash showed fuel injection failures leading to burnout of the Il-18 combustion chambers (AW Oct. 10, p. 37).

CAB Opens United-Capital Hearing As Stockholders Approve Merger

By Robert H. Cook

Washington—Merger plans of Capital and United Air Lines faced the final hurdle of Civil Aeronautics Board approval as hearings opened last week in the wake of overwhelming endorsement by the airlines' stockholders.

United stockholders approved the plans in Chicago by a vote of 3,291,237 to 35,014 on a ballot representing more than 80% of the carrier's outstanding shares. At the same time, Capital stockholders, who will receive one share of United stock for each seven of Capital, approved the merger agreement 677,687 to 34,604.

Total votes at both meetings met a stipulation of the agreement that final approval be conditioned on an affirmative vote representing two thirds of the shares held by each company. First announced jointly by Capital and United on July 28, the merger proposal was approved by the boards of directors of both airlines Aug. 11.

Prior approval of managements and stockholders cleared the way for hearings before CAB Examiner Thomas Wrenn, who heard initial testimony from United President William A. Patterson and Thomas D. Neelands, recently elected chairman of Capital's board of directors.

Additional testimony from Raymond G. Lochiel, Capital treasurer and vice president, emphasized the airline's need for the merger because of its worsening financial plight.

United's motivation in seeking to acquire Capital includes not only an opportunity to gain new routes and eliminate a competitor, Patterson said, but also a means to "remove a serious threat" to the credit of the entire industry. Referring to Vickers-Armstrongs threats to foreclose on $34 million due the manufacturer on Capital's Viscount aircraft, Patterson called attention to the jet financing problems of many carriers and noted that he "felt strongly that bankruptcy or foreclosure upon the assets of a major domestic trunkline would materially and adversely affect the ability of the industry to obtain the additional financing which it will require on reasonable terms.

"Over-all," he said, "I saw in the Capital merger a substantial addition to United's revenues. I felt that we in United had built up a management team which could handle that business with a minimum amount of additional overhead cost, and that the experience of Capital should not be indicative of what the results would be under a combined United-Capital operation. A large part of Capital's troubles had stemmed from the high annual carrying charges on its debt."

Major drawbacks to the merger primarily concern Capital's turboprop Viscounts and what to do with them, Patterson said. Contending that the Viscounts cannot fully compete with more modern turbojet and turboprop aircraft, Patterson explained that United has a surplus of piston-powered aircraft which it has been unable to use or sell and "the prospect of adding to our fleet 41 aircraft for which we will have no permanent place, was a matter for some concern."

In addition, he said any chance for United to realize tax savings through future depreciation on the aircraft has been reduced because of Capital's practice of listing Viscount valuations lower for tax purposes than carried on the company's books. This resulted in the assets of Capital being worth a "good many millions of dollars less" to United than the valuations listed in Capital's accounts.

Patterson told the examiner that, in the event of a merger, United will offer each Capital employe work at wages equal or higher than those they now have, and will also agree to whatever protective labor provisions the CAB might require.

United's Intention

Underlining the importance of acquiring Capital's route system and criticizing the past requests of many carriers that the Board place heavy restrictions on any routes gained by United through a merger, Patterson stated that "United has no intention of paying for a part of Capital's assets the price which it has agreed to pay for all. Furthermore, and regardless of any question of price, United has no interest in a merger with Capital which would not provide access to the markets represented by Capital's Route 51. If the merger cannot be approved upon the terms agreed upon by United and Capital, it will be abandoned."

Capital Board Chairman Thomas Neelands traced the early negotiations which finally led to the agreement with United as the "one carrier with the necessary financial strength, and the necessary equipment to take over Capital, to satisfy Vickers, and to provide protection for Capital's employes, debenture-holders and stockholders."

Less than two weeks after being elected chairman, Neelands said a possible three-way merger with Northwest and Delta was discussed and later abandoned because of Delta's involvement in the Southern Transcontinental Case. Northwest alone, he said, did not appear to have the necessary combination of financial and equipment strength needed to satisfy Vickers.

Following his return from the first talks with Vickers in London, a possible four-way merger with National, Continental and Trans Caribbean was suggested by O. Roy Chalk, president of TCA, Neelands said. This also was dropped, he said, two days after Capital and United reached an agreement.

Capital's serious financial plight was outlined by the airline's treasurer, R. G. Lochiel, who told the examiner that it is doubtful if Capital can survive through the winter. Losses during the first nine months of this year, he said, will amount to $8.2 million, including interest on the Vickers debt. As of Sept. 30, 1960, the airline had a cash balance of only $4.1 million, of which $1 million is not immediately available and as much as $2.3 million could be required to meet tax and payroll bills which might fall due on the same date, he said.

FAA Expands Control Over Traffic Areas

Washington – Federal Aviation Agency will expand its system of positive control of aircraft on major route segments to cover entire areas throughout the U. S.

At the same time, the agency has proposed a rule which would standardize air traffic patterns and impose speed limits within a radius of five miles of the center of tower-equipped airports. Both programs are designed to minimize the danger of midair collisions and increase the utilization of airspace.

Positive control for aircraft operating between 24,000 and 35,000 ft. has been established under radar control over a 110,280 sq. mi. area over Indiana, Illinois, Ohio and parts of Wisconsin, Kentucky, Iowa, West Virginia and Michigan. Air route traffic control centers at Chicago and Indianapolis will be responsible for traffic operating in this area.

Under the proposed rule calling for standardization of traffic patterns at tower-equipped airports, all aircraft would be prohibited from flying through an area below 2,000 ft. altitude and within five mi. of the airport's center unless it intended to make a landing. Speed limits of 180 mph. would be established to apply to all aircraft operating within the area, and two-way radio equipment would be required on all aircraft operating into any airport where a control tower is in operation.

Ft. Worth Case Ruling Protested by American

Washington—American Airlines, protesting a Civil Aeronautics Board order for improved service to Ft. Worth, has questioned the Board's legal authority to "schedule the airline by administrative fiat" and charged the order was part of a pattern that is plunging the agency "into a management role rather than a regulatory role."

The airline asked the Board to withdraw its order in the Ft. Worth Adequacy of Service Case (AW Sept. 26, p. 39), which directs American to provide daily round trip turbine-powered flights between Ft. Worth and Washington and New York. In its petition, American said the order is based on bad principle and added that it is impractical to execute. It said the order would arbitrarily and illegally transfer millions of dollars in business to its competitor, Braniff Airways.

IATA Carriers Cut Long-Haul Fares

Cannes, France—Long-haul fares between North and South America will drop as much as 35% under a new fare structure agreed upon last week by International Air Transport Assn. members at their Traffic Conference here.

Also under the new agreement, an economy class fare will be instituted on the Pacific at 14% below existing tourist rates. Lowest year-round fare between the U. S. West Coast and Tokyo will be $435 in jets and $405 in propeller aircraft. There also will be special group rates for 35 or more persons traveling together which will provide a further 30% reduction.

Under the Western Hemisphere agreement, New York-Buenos Aires round trip fare will be $599 in jets and $538 in propeller planes. The fares formerly were $934 and $878 respectively. First class fares, however, will be increased up to 10% in service between the Americas.

Fares on the North Atlantic will remain approximately the same, but economy class passengers will in future be served hot meals. Mid-Atlantic fares will remain about the same, and special family fares will be introduced on the South Atlantic routes. Fares in other areas of the world will remain relatively unchanged except for expansions of special tour fares.

Cargo rates were revalidated at existing levels. Most of the new passenger fares are scheduled to go into effect Dec. 1 or Apr. 1 and to be effective until Mar. 31, 1963, instead of for 12 months as in the past.

Seaboard & Western Refinance Program

New York—Seaboard & Western Airlines' stockholders have approved a reverse stock split in connection with a new financing program. Seaboard recently has been retrenching financially (AW Oct. 10, p. 34) and is seeking money to pay for Canadair CL-44 turboprop cargo aircraft scheduled for delivery next year.

The stockholders approved a plan of trading one share of new $3 par stock for three shares of $1 par stock. This will reduce the number of shares outstanding from 1,056,000 to 352,000. The financing program calls for raising about $6 million in cash, an additional $1.6 million in credit available between June, 1961 and June, 1963, and deferring of obligations that otherwise would have to be paid in 1960 and 1961.

When the refinancing is completed, the shares outstanding will total about 1,600,000. Convertible debentures and warrants, when converted or exercised, would raise the total to 4,300,000.

DC-8 Wing Change

Los Angeles, Calif.—Douglas Aircraft Co. will sharpen the leading edge of the DC-8 jet transport wing and extend wing chord 4% along the entire span to improve range, speed and payload.

In a report to the Society of Automotive Engineers, Douglas said major reason for the leading edge change was to reduce high velocities on the section to cut drag under high lift and Mach number regimes. New shape increases wing area from 2,773 to 2,868 sq. ft. and will be included on all DC-8s starting with the 148th plane.

Company claims the modification will increase specific range 8%; raise speeds Mach .02, and cut direct operating cost 2.2% per 200-lb. mi. On long range flights, Douglas added, payload may be increased by 7,000 lb. Aircraft previously received Federal Aviation Agency approval for installation of leading edge slots (AW Feb. 1, p. 28).

Landis Backers Claim Support

New York—Backers of James M. Landis, former Civil Aeronautics Board chairman who seeks election as Air Line Pilots Assn. president, claimed last week that their candidate had won commitments of support from a majority of ALPA councils within American, Pan American, TWA, Delta and Eastern Air Lines.

A spokesman for the Landis-for-president national committee told AVIATION WEEK that all eight Eastern councils had instructed their delegates to ALPA's Nov. 14 convention to vote for Landis. He estimated that 70 to 80% of the TWA councils, about 70% of the PanAm councils, three of the five Delta councils, and a majority of the American councils were opposing incumbent President Clarence N. Sayen. Only United, the Landis camp reported, remains "on the fence."

Because Landis is not an airline pilot, 200 of the 300 representatives on ALPA's board of directors must favor placing his name in nomination. Moreover, the directors (the chairman and senior copilot representative from each ALPA council) cannot be bound by the votes of their councils under association bylaws.

Landis' campaign headquarters, which occupies a section of Landis' law offices here, said that proxies soliciting support were being mailed to the entire ALPA membership. These would be returned to the local Landis-for-president chairman in an effort to avert any rebellion among pledged delegates at the convention.

Flight Engineer Strike Halts Northwest Jets

Washington—Northwest Airlines has suspended its Douglas DC-8 service and furloughed nearly 700 employes as a result of a two-week-old strike of 28 flight engineers.

Northwest said its four turbojet transports were grounded as the result of a walkout of International Assn. of Machinist flight engineers over an interim wage offer of $1,500 a month for international jet flights, compared with the engineers' demands for $1,900. The strike has been carried out only by engineers assigned to jet flights and does not involve an additional 250 flight engineers serving on piston-engine aircraft, the company said.

Hope was expressed by the company that the issues might be settled at a planned meeting; Northwest was scheduled to meet later last week with representatives of the striking engineers and the National Mediation Board. Majority of workers furloughed as a result of the strike were assigned to DC-8 maintenance.

CSA-Air India Pool

Prague—Czechoslovak Airlines has signed a pool agreement with Air India to extend CSA Far Eastern service beyond Baghdad to Bombay and Jakarta. The two airlines are offering twice-weekly service over the Prague-Bombay route, with the Czech airline operating its Tu-104 transports on its flights.

Airlines Analyze Maintenance Cost Shift

By David H. Hoffman

Kansas City, Mo.—Sweeping redistribution of the airline dollar spent for maintenance and overhaul sparked top interest among high-echelon airline engineers meeting here to analyze second-round problems of the industry's transition to jets.

Discussion centered on what maintenance and overhaul techniques would boost jet utilization and on how the forecast cost of overhauling jet airframes and engines squared with reality. But the underlying issue at the three-day Engineering & Maintenance Conference of the Air Transport Assn. was the basic cost shift taking place within the industry.

As the inherent productivity of the jet transport drives direct operating costs down, H. J. Heinrich, planning superintendent for Trans-Canada Air Lines, reported, "overhead probably will go up to pay for buildings and ground equipment specially bought to accommodate the jets." In maintenance alone, this trend may lead to a 50 cent excise for overhead on every dollar invested in the aircraft, he said. Today, about 30 cents per maintenance dollar is eaten up by overhead.

A 50-50 balance between labor and material costs in maintenance prevailed during piston days. But according to Heinrich, material costs have outstripped labor costs by proportions of three to one and threaten to soar even higher (AW June 13, p. 47).

Component Cost

Largely responsible for the reapportionment are about 20 high-cost engine components. As airline turbojet overhaul swings into high gear, these items alone will account for about 50% of direct maintenance costs, Heinrich predicted. If carriers refuse to deviate from the piston-days practice of paying for parts as used, the penalty will be a seven-fold increase in engine material costs, he said.

With the cost theme interlacing their presentations, other engineering officials at the conference detailed the status of maintenance and overhaul within the industry. From their reports these key points emerged:

• **Airlines still** are highly satisfied with the Boeing 707, Douglas DC-8 and Convair 880 airframes and with their Pratt & Whitney and General Electric powerplants. Support services offered by all five manufacturers, especially in de-bugging programs, were rated excellent, drawing congratulatory comment from speaker after speaker.

• **Vibration** of the Pratt & Whitney JT4 turbojet is today's most pressing powerplant problem. As of Sept. 16, Pan American had discovered and rejected 31 JT4s with excess vibration out of 598 engine runs accomplished at its New York International Airport jet overhaul base. Several other carriers have the same problem in proportional magnitude.

• **Carriers locked in competition** for available passengers are nevertheless pooling their top technical talent in an effort to devise equipment fixes. Sharing of engineering know-how is most prevalent among local service airlines operating similar aircraft. Under the impetus of rising material costs and sales department pressure to boost utilization, this trend toward interline cooperation in solving technical problems is accelerating.

• **Massive accumulation** of jet operating experience has tended to obscure the importance and the cost of individual fixes accomplished by the airline-manufacturer-component vendor triad. Significant design improvements no longer are reflected by sharply decreased mechanical delay rates.

• **Percentage of jet departures** delayed by mechanical malfunctions remains higher than comparable piston percentages. Trans World Airlines, which experienced a 13% departure delay rate during its first nine months of jet operation, has trimmed this figure to the industry average of about 6.5%. Mechanical delay rate for TWA's piston fleet, by contrast, is about 4%.

• **Wide variations** exist in how carriers go about overhauling the jet airframes. Braniff, Continental, TCA and Mohawk, for example, have or will adopt the continuous maintenance concept, which softens the impact of workloads at airframe allowable time by spreading them over a series of periodic checks. American uses a modified form of the same plan. Majority of the carriers, however, have not switched from block overhaul systems as yet.

• **Aerodynamic cleanliness** programs undertaken by the carriers and flight characteristic improvement programs undertaken by the manufacturers are holding down drag on the jet airframe. Computer analysis of recorded block-to-block times fails to shown any significan speed deterioration in older 707s and DC-8s.

• **Jet inventory costs** and the overriding importance of high utilization are complicating maintenance's historic dilemma: how to achieve high operating regularity at minimum expense to the company. Inventory must be increased before in-process overhaul time—the key to spare engine requirements—can be reduced. Thus Pan American, which overhauls 11 turbojets a week on 16-day cycle times, already has $3,470,000 tied up in P&W engine parts, with another $2,050,000 worth on order.

• **Prime problem** with Fairchild's F-27 twin turboprop transport used by local service carriers is the short service life of the plane's center wing section. Although the F-27 airframe has an allowable time between overhaul (TBO) of 10,000 hr., "safe life" of the center wing section has been fixed at 7,600 hr. by a Federal Aviation Agency airworthiness directive. The FAA limitation only applies to the first 61 F-27s, but most of these went to U. S. airlines.

• **Emphasis and study** of new nondestructive inspection techniques is on the increase. Ultrasonic sound, eddy-current and X-ray testing are ensuring that seemingly sound parts are not scrapped because of surface defects which, to the eye, create suspicion of inside cracks.

TBO Report

Now in its 20th month of Boeing 707 operation, Trans World Airlines has attained TBOs of 1,400 and 1,200 hr. respectively on its JT3 and JT4 engines. In a report outlining this experience, John F. Roche, manager of aircraft and systems engineering for TWA, said that the costly requirement of mid-TBO hot section inspection recently has been eliminated.

Although TWA's 707-300s are amply powered by JT4 engines, Roche said, "the domestic aircraft which is fitted with the JT3 could be benefited with some added thrust." He referred to the 15 707-120s operated by TWA and touched off speculation that TWA might follow the lead of American Airlines in converting its entire 707-120 fleet to P&W JT3D turbofan power.

Turning to current bugs in the 707 airframe and systems, Roche recommended the installation of zone temperature controls in the spacious, compartmentalized 707 cabin to remedy a situation analagous to what "we would find in a rambling ranch-house" with one air conditioner.

Three problem areas have been spotted in the 707's main landing gear by TWA: shock strut cylinders with low fatigue resistance to stress generated by tight turns at terminal gates; trunion support structures that suffer brittle fractures, and strut seals that leak.

Trunion support cracks, Roche said, should concentrate industry attention on the need for technical advances in metallurgy. Because of the expanding use of high strength steels in aircraft construction—steels in the 220,000 to

240,000 psi. heat treat range that are hypersensitive to variations in heat treat, machining and maintenance processes—airline engineers must familiarize themselves with some strange concepts, Roche said. He added:

"Many of you who cut your eyeteeth on DC-2s, DC-3s, 247s and the like never heard of decarburization or hydrogen embrittlement. Neither did you concern yourselves with the kind of chemical used to strip or degrease a heat-treated steel part, nor did you concern yourselves greatly when a heat treated part was cadmium plated as to whether the plating process adhered strictly to the prescribed specification." Roche strongly implied that such disregard today would wreak havoc in a jet maintenance shop.

De-icer boots on the surface of the 707's empennage, according to TWA, are "in need of radical improvement," with some months requiring 80 to 100 boot repairs. To avoid tying up the aircraft, these repairs often entail leading edge removal and replacement, an operation requiring a minimum of 10 elapsed hours and a big stock of leading edge spares ($6,000 to $8,000 each).

Instrumented Boots

One TWA 707 now is flying with a set of instrumented boots under a joint Goodyear-Boeing-TWA program aimed at obtaining data on the environmental temperatures in which boots are operated. If this approach fails to find a fix, TWA recommends a re-examination of whether the jet airframe demands this type of de-icing protection.

Plaguing the 707 from its first introduction has been the problem of false fire indications and the emergency action that they trigger in the cockpit. At TWA, fire detection system failure rates still are averaging about .2 per 1,000 flight hours.

Fuel dump chutes that fail to release and cracked heated (nesa) windshield panels complete TWA's list of uncliminated system bugs. Of these two, TWA rates nesa breakage the more important, for panel replacement rates now average about .67 per 1,000 flying hours.

Defective panels, moreover, require about 8 hr. to replace, with new panels costing up to $1,150.

Even more severe windshield difficulties were encountered by United Air Lines in its DC-8 operation, now 13 months old. L. W. Olson, assistant manager of service engineering for United, told ATA's conference here that his carrier's DC-8s were grounded for as long as 36 hr. by a windshield problem requiring replacement of more than 100 panels. After a series of fixes were incorporated, United delays and cancellations attributable to faulty windshields fell from a peak of 2.2 per 1,000 flight hours last winter to a current rate of .5 per 1,000 hr.

Second-ranking problem to be eliminated at United concerned the DC-8's fuel quantity indicating system, a problem consistently aggravated by improper maintenance procedures. A trouble-shooting team composed of carrier engineers and representatives of the vendor, Liquidometer Co., toured United stations, explaining fixes and lecturing on correct maintenance techniques. Their work was reflected in a delay rate that plummeted from 4.3 per 1,000 flying hours last spring to .3 per 1,000 hr. this summer. Further relief came from the FAA, which relaxed its regulation requiring a full complement of working fuel gages for station dispatch.

United's biggest maintenance headache today stems from strut seal leakage in the DC-8 main landing gear, a problem the carrier shares with TWA. Analysis at United has disclosed that the strut cylinder surface actually forms an ellipse under extreme turning loads. As the cylinder deforms, pressure extrudes the seal into this hollow. Then, when the load is removed, portions of the strut seal are "nibbled" away by the cylinder's resuming its normal shape.

Recent emphasis on prompt brake application to slow the DC-8's landing roll has given rise to another United problem—short brake service life.

Last unresolved problem area underscored by Olson was the DC-8's Freon air conditioning system. Corrective action programs aimed at the cabin compressor, Freon compressor, Freon hose and Freon condenser air selector valve "are not expected to show marked effect until later this year when 'fixes' will be accomplished during airplane overhaul," Olson reported.

Ranging beyond the typical troubles of the learning curve, Olson criticized:

• **Inability of suppliers** to furnish modified parts. "All too often we spend much time convincing the manufacturer that his product is unreliable," Olson said, adding that even then the vendor's usual response is a request to return the part for modification. But because high failure rates have consumed spares available at the airline and at the manufacturer's plant, there are no parts to return or modify.

• **Difficulty in exercising** the "alleged benefit" of parts warranty. To take advantage of warranties, United often must cut back inventory, then experience long lags in recovering serviceable parts from extended pipelines, said Olson. At best, development of inside know-how and shop efficiency is stunted.

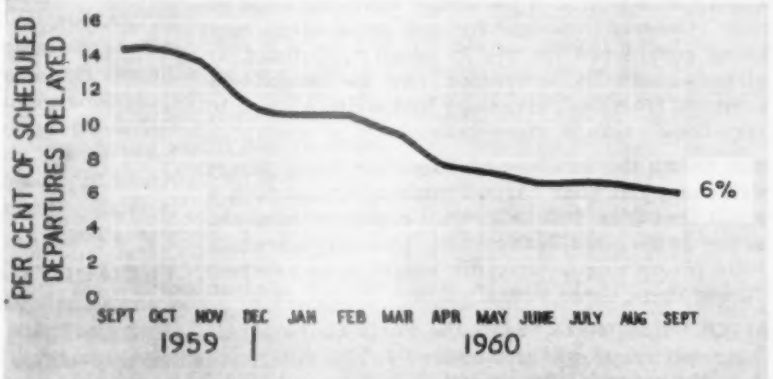
• **Loss of the airline's** voice in establishing the go, no-go equipment required for dispatch. At one time, Olson said, carriers could work with the local FAA safety agent, usually a person well-informed on the individual airline's maintenance philosophy and empowered to approve deviations from the full complement of equipment. Now the carriers must deal directly with the FAA in Washington.

Economy Measures

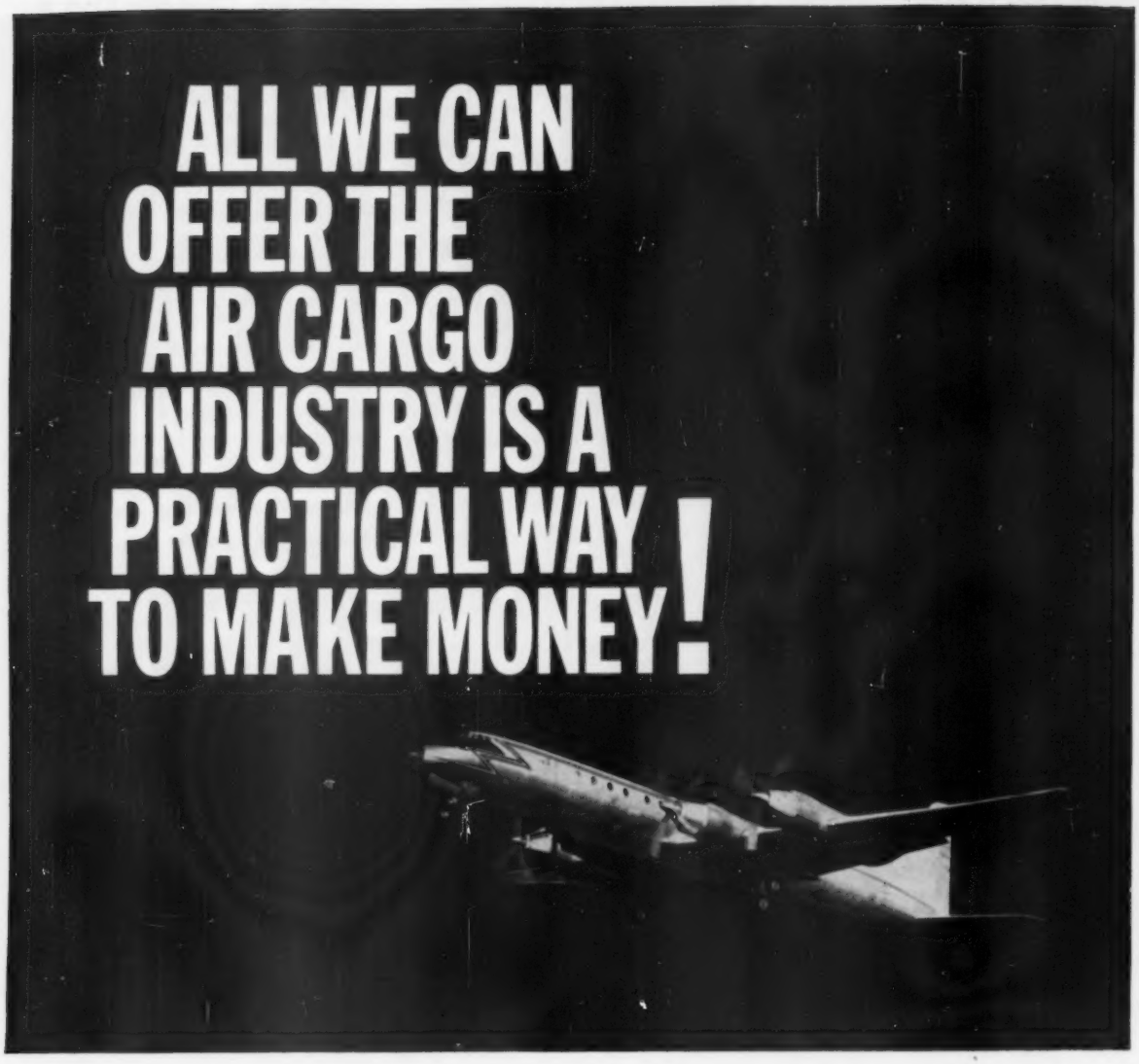
To solve the economic impasse of the jet age—decreasing direct operating costs in the face of increasing overhead and material expenses—Heinrich of Trans-Canada urged the airline industry to concentrate on expanding its business volume.

"This," he said, "will absorb some of the excess plant capacity and permit a wider spread of indirect cost. Not only will the overhead rate drop accordingly but the unit cost of production [the cost per ton mile or flight hour] will also come down, thus permitting much lower break-even load factors."

Impact of staggering component cost fluctuations can be softened, Heinrich feels, by budgeting overhaul reserves in precise amounts based on a thorough understanding of engine behavior. Concurrently, with scientific techniques offered by operations research and made feasible through electronic data processing, the industry must "learn a great deal more about the life development



DECLINING delay rate attributable to mechanical malfunctions in the combined Boeing 720 medium range fleet is mapped by the above curve. Industry average of 6% still exceeds comparable rate for most piston aircraft.



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YOUR piston powered passenger carrying aircraft now rendered obsolete by new equipment, and being considered for use in cargo operations, or already actually converted can be completely removed from fleet inventory and written down to zero book value in three years;

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Any consideration of a specific example requires certain assumptions regarding scheduling, future rates, and load factors, but, under a representative set of conditions our analysis indicates: —that a fleet of 25 piston powered aircraft currently being converted into cargo carriers, could be replaced and retired by a fleet of 8 Forty Fours. The above assumptions and statements are based on the unlikely premise that cargo rates will remain at present levels. If they are reduced, as seems inevitable, the situation will favor the Forty Four even more strongly.

THE FORTY FOUR. The Canadair Forty Four, with its combination of low direct operating costs, high block speeds and large payload capacity, is the world's most economical cargo aircraft. Delivery schedules can be arranged to introduce the Forty Four into airline service fourteen months from contract agreement.

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of engines and especially their few high cost components," Heinrich said.

If cost cutting penalizes the operating regularity of an airline, Heinrich told ATA, fleet utilization drops and earnings suffer. "Since a jet can bring in revenue at four times the rate of its direct operating cost, the ability to exploit the available market is far more important than the cost of doing it," he warned.

Industry Effort

Heinrich concluded his report by appealing for an industry-wide effort to:

- **Design "a realistic unit"** of replacement for the available ton mile. This fails as a measure of fleet productivity because it fails to distinguish the economic value of big jets operating side-by-side with piston-driven transports within the same airline.
- **Develop a system** for overhead allocation that would enable calculation of the "true total operating cost of an aircraft fleet" and assess the effect of changing utilization, fleet composition and passenger vs. cargo configuration.
- **Create a long-range planning** system capable of being computerized. Thus the infinite policy alternatives available to an airline quickly could be analyzed.

Airline engineers, despite their impressive record of improvising jet fixes and design changes, have been stymied by the trunkline industry's number one turbine engine problem: JT4 vibration.

Engine Rejection

Martin W. Taylor, superintendent of jet engine overhaul at Pan American, looks upon it as a riddle—a riddle responsible for the rejection of 4.76% of the engines overhauled at his Idlewild shop. Right now, he reports, a Pratt & Whitney team resides there, and their instructions are to stay until some fix is found.

Solution of the vibration problem probably will be based upon a list of statistical premises developed by PanAm. Among them:

- **Pan American uses JT4 engines** with compressor sections built of both steel and titanium. There are 4.1 titanium engines for every steel engine in the carrier's inventory. But for every titanium engine rejected during post overhaul test cell inspection, nine steel engines are turned back.
- **JT4 readied for Boeing 707** installation but found to have excessive inlet vibration often—but not always—will test satisfactorily when fitted with a Pratt & Whitney bellmouth or Douglas inlet.
- **All JT4s disassembled** for inlet vibration have contained N_1 compressors that were highly unbalanced. But up to 70 consecutive powerpacks have been run through PanAm's post overhaul test cell without one case of high vibration.

Pan American has yet to reject its first Boeing 707-120 series JT3 engine for excess vibration. Nor has a DC-8 powerpack been rejected for high vibration out of 63 engines tested.

Engine Hours

Through Sept. 1, PanAm had accumulated more than 420,000 engine hours. It had changed 990 engines, removing 95 JT4s and 73 JT3s prematurely. In terms of time, the carrier experienced one 707-JT4 premature removal every 2,600 engine hours, one DC-8 JT4 premature removal every 3,260 hr. and one 707-JT3 premature removal every 1,800 engine hours. All engines prematurely removed were found to be repairable.

PanAm's global route structure, explains Taylor, tends to hold down hours logged between early removals. "Eleven times a week," he said, "we put a big jet on an around-the-world pattern that averages 112.8 flight hours before our main engine change point will see it again. Because of this, we must watch for signs of trouble" and take action promptly.

Reviewing major problems of the first two years, Taylor reported that of the basic JT4 removals at Pan American, 15 were attributable to inlet guide vane cracking, six to improper rotating assembly balance, five to diffuser case cracking and four to bearing seal failure. Turbine seal erosion accounted for nine basic JT3 removals, out of balance compressors for five, bearing failures for three and N_2 accessory drive gear faults for three.

Engines flow through Pan American's Idlewild overhaul shop in a straight line, one behind the other, and are scheduled for release in the same order. Working with up to 29 different powerpack combinations simultaneously, PanAm has found that the various JT3/JT4 combinations are "quite compatible" in their shop overhaul requirements.

Overhaul Time

To overhaul each 707 powerpack (the entire installation as it's hung on the aircraft pylon as opposed to the basic engine furnished by Pratt & Whitney) requires about 1,620 PanAm man hours. An additional 100 are expended on DC-8 engine overhauls.

These figures should drop to about 1,200 man hours next year, according to Taylor.

Industry's basic approach to turbojet overhaul may be reshaped at Pan American if Taylor gains company, FAA and Pratt & Whitney approval for his "equalized service" concept. Breaking sharply with present practices, Taylor proposes overhauling the turbojet's eight major subassemblies separately under individual TBOs tailored to each unit's current service life.

Thus, overhauled subassemblies could be substituted as often as necessary to advance over-all engine TBO. If this scheme was adopted, Taylor told ATA, "our shop would become a job shop feeding these eight assemblies and other miscellaneous pieces to the service group, which would replace them on an 'as required' basis during the periodic visits of the engine."

Another new maintenance concept, this one pertaining to the airframe, has been originated at American Airlines to accompany phase-in of its 707-120 fleet. Rather than overhauling the jets in a single operation, American elected a compromise calling for a series of periodic checks with one, the eighth or "main base check," substantially larger than the others.

To accomplish the main base check, scheduled for the 2,400 hr. mark, American routes its 707-120s back to the company overhaul base at Tulsa, Okla. All other periodics take place at en route stations with major maintenance capability.

Planning Team

Preparing in advance for its first main base check, American appointed a planning team and charged it with responsibility for work-card preparation, job standards, work flow charts, tooling and materials procurement. During the period preceding the main check, aircraft interiors were examined closely to properly provision often overlooked parts—peculiar screws, fasteners, seals.

American's Overhaul Division, meanwhile, determined that nine working days would be required to run one 707 through the check. This included two days time for installation of a modified rudder boost system at Boeing's nearby plant in Wichita, Kan. Thus, aircraft arriving on Friday night were released by maintenance the following Friday, test-flown over the weekend and returned to productive duty on Monday.

Man hours expended in routine scheduled work on American's fleet of 24 707-120s totaled 30,047, 8.5% more than were forecast. But non-routine, or repair workload, was completed in 58,445 man hours, a figure 7.4% less than company had forecast.

Each first-round main base check cost American $17,110 in material, plus 8,484 man hours of direct labor. Average airframe yielded 2,042 hr. at check time.

American, satisfied with first visit results, has jumped the interval between first and second main base checks from 2,400 to 4,000 hr. In March, when second visits are scheduled to begin, the checks will be accomplished in seven-day cycle times without benefit of learning curve allowances.

Few of the top turbine problems confronting the big trunks are shared by local service operators of the F-27,

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with the exception of rising material costs.

With the F-27 phase-in period well behind them, these carriers are now concerned with technical liaison between themselves and the Fairchild factory. This, they feel, is necessary to plug the gap left when the manufacturer's representatives departed from airline operating bases.

At ATA's conference here, local service delegates were weighing the appointment of a common representative who would speak for F-27 users at Fairchild's Hagerstown, Md., plant. His office, it was felt, could serve as a focal point for the exchange of technical data on these high-priority F-27 problems:

- **High maintenance costs** per revenue passenger mile. First forecasts of Piedmont Airlines indicated that its F-27 fleet could be maintained for 18 cents per passenger mile, but current costs average 40 cents per mile.
- **Fleet-wide expiration** of airframe TBO's within a short time span. To avoid tying up all their aircraft at one time, several carriers have elected to take the penalty involved in overhauling their aircraft in advance of allowable TBO.
- **Disproportionate cost** of wheel and brake components and tires. Although the carriers' current F-27 bug list includes air conditioning, water injection, propeller synchronization, a.c. generator and metal fatigue problems, almost half of some airlines' parts expenditures go for wheels, brakes and tires.
- **Inability to predict total** cost of first airframe overhaul. Piedmont, "strictly as a guess," is budgeting $75,000 per aircraft to accomplish overhaul when due. Some other lines aren't budgeting anything for this purpose.

Delta Experience

Delta Air Lines, which introduced the Convair 880 on scheduled service this summer, still applies learning curve allowances to most of its maintenance operations.

Through September, the carrier had logged 15,559 engine hours and 3,890 aircraft hours. Despite four in-flight and 14 off-schedule removals of the General Electric CJ805-3 turbojets used on the 880, Delta rates its initial engine operating record "very satisfactory."

Only three of the prematurely removed engines were considered failures—one resulting from a plugged oil jet that caused bearing failure and two resulting from thrown third-stage turbine buckets.

According to Delta, there have been four industry-wide instances of CJ805-3 turbine bucket failure. The two it experienced came at engine times of 344 hr. and 507 hr. A third engine failed during TWA's crew training program at the 137 hr. mark, and a fourth operated by General Electric failed at one hour.

It is interesting, noted Arthur C. Ford, Delta's superintendent of engineering, that the airline failures occurred on engines with serial numbers 241, 242 and 248.

Fuel Consumption

An increase in 880 fuel consumption of about 1,000 lb. per hr. has been experienced by Delta, Ford said. Although this is higher than General Electric and Convair intended, industry rumors have tended to exaggerate the 880's specific fuel consumption, which Delta feels will drop to original goals after a series of modifications are implemented by the two manufacturers.

Delta's average 880 utilization rate has reached 7:06 hr. daily, despite trip distances that average only 650 mi. and the necessity—common to regional carriers—of tailoring schedules to meet connecting passengers. By the end of the year, Delta plans to serve about 13 cities with nine 880s.

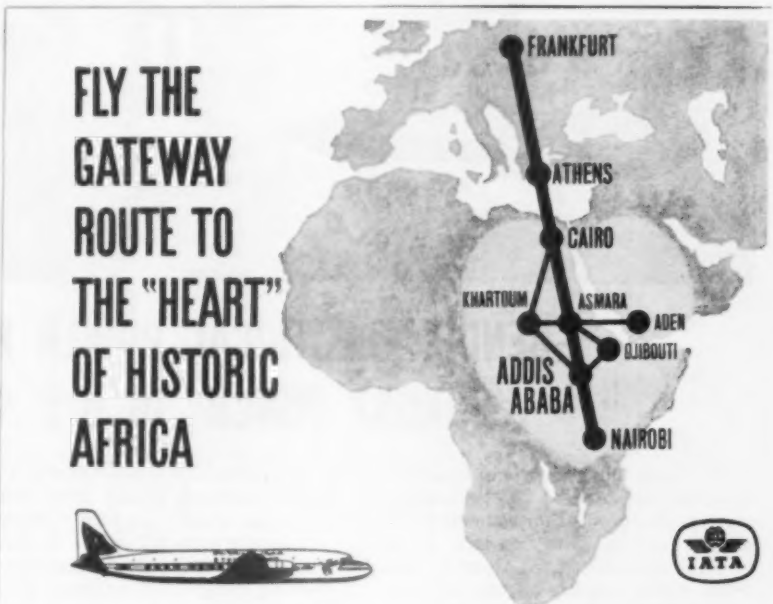
To phase in the aircraft required 92,077 man hours of maintenance and inspection training, Ford reported. Learning curve allowances have been discarded in performing daily 880 checks (two men working an elapsed time of one hour) and turn-around checks (one man working 15 min.).

Delta's 880s are yet to undergo 2,500 hr. checks during which long lists of minor modification will be accomplished. Predicted requirements for 2,500 hr. overhauls, however, are 2,500 man hours and an elapsed time of five days. With most design deficiencies already corrected, Delta is turning its attention to component dependability, which "now has the greatest detrimental effect on schedule reliability," Ford told ATA.

To illustrate the magnitude of what Delta calls its "Project De-Bug," the airline has released 292 modifications for production during the first three quarters of this year. By classification these include 55 system, 37 structure, 89 electrical and instrument, 47 power pod and 64 furnishings improvements.

In addition, Delta has 184 projects in design or implementation stages. Included are 40 system, 34 structure, 55 electrical and instrument, 32 power pod and 23 furnishings modifications.

Best features of the 880, in Ford's order, are: simple, straight-forward structural design; easily removed packaged Freon system; pneumatic system with a minimum of operating parts; scotch weld process used in wing assembly and as a fuel sealant and "of course speed and beauty."



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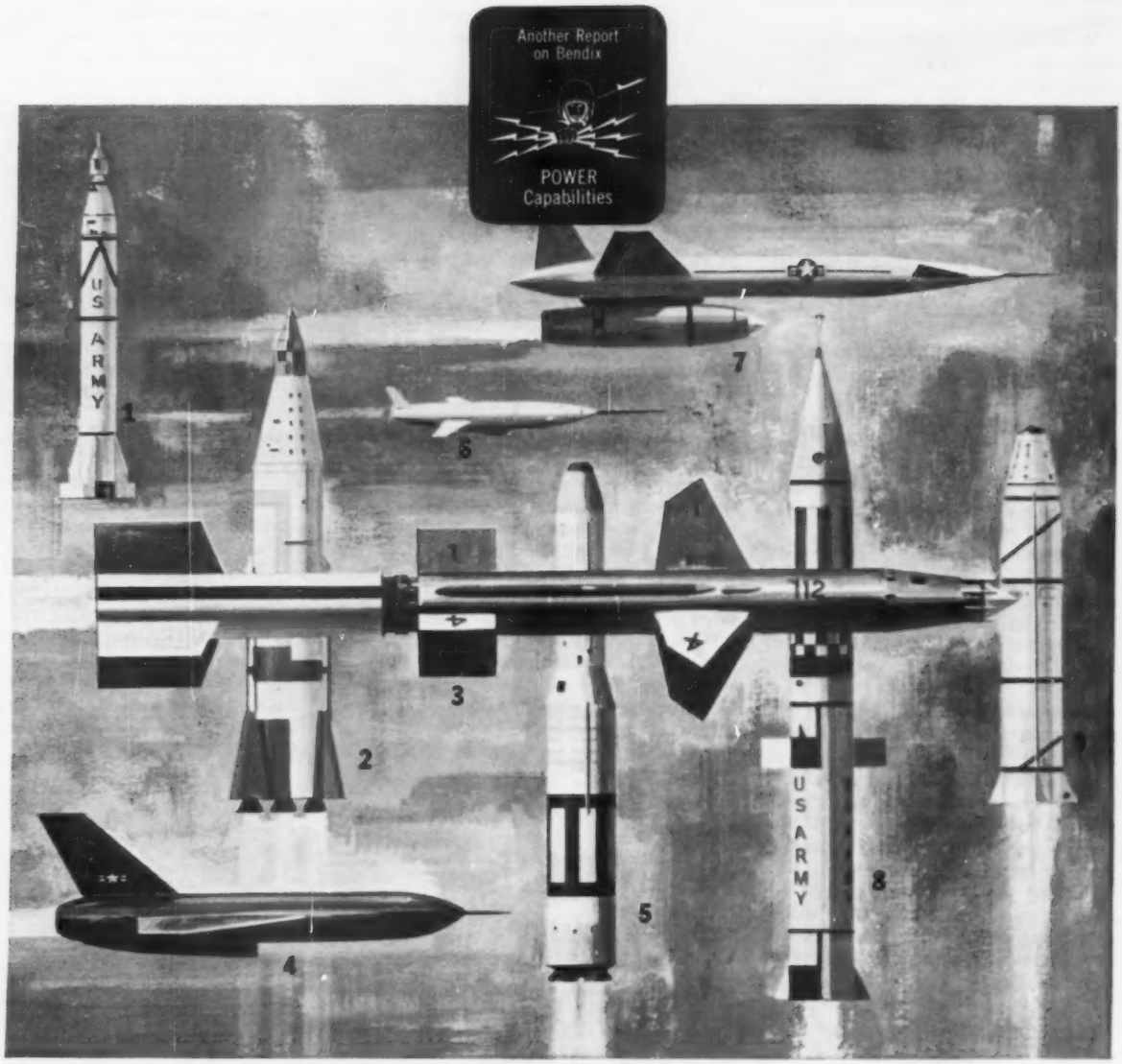
ETHIOPIAN AIRLINES

THE WONDERLAND ROUTE



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Airline Traffic—August, 1960

	Revenue Passengers	Revenue Passenger Miles (000)	Passengers Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor %
DOMESTIC TRUNK								
American	728,652	599,757	67 2	1,784,550	1,049,485	9,610,914	69,916,966	56 1
Braniff	189,402	92,816	58 3	456,569	175,265	696,713	10,225,168	47 6
Capitol	313,264	128,146	52 3	555,091	299,892	480,589	13,614,213	48 6
Continental	130,260	90,089	52 5	223,722	118,517	459,323	9,427,125	42 1
Delta	278,750	148,819	55 8	484,301	312,530	1,251,589	16,333,775	47 3
Eastern	654,053	342,917	51 89	1,169,289	573,104	1,911,457	36,635,288	40 57
National	124,248	72,951	49 2	282,332	57,480	607,186	7,976,661	38 2
Northeast	137,637	46,223	47 9	115,667	41,025	208,420	4,785,964	41 6
Northwest	171,224	128,888	61 4	623,025	314,333	1,534,503	14,809,593	54 3
Trans World	444,794	453,857	68 9	1,536,392	784,319	3,680,334	49,456,301	53 7
United	734,643	547,464	70 7	3,087,450	964,955	6,478,846	62,994,766	59 6
Western	152,073	92,226	61 5	300,225	101,355	314,179	9,539,025	55 0
INTERNATIONAL								
American	9,885	10,421	63 7	8,860	384	191,671	1,277,531	64 9
Braniff	6,269	12,833	58 8	38,725	.....	154,970	1,556,050	52 0
Caribbean Atlantic	37,534	2,691	66 5	1,917	.....	9,247	262,410	64 6
Delta	2,617	3,562	63 1	2,318	.....	23,675	415,138	57 5
Eastern	51,660	75,119	63 74	86,661	.....	284,989	7,292,921	40 68
Mackey	12,492	3,579	58 2	.....	174	3,468	391,450	62 2
National	3,069	2,322	61 7	3,515	460	5,581	261,819	57 9
Northwest	16,218	38,642	57 5	1,260,193	21,453	953,341	6,332,225	60 3
Pan American								
Alaska	8,624	9,128	72 0	36,346	.....	187,066	1,163,939	69 1
Atlantic	179,110	237,656	65 2	1,968,386	.....	4,202,330	30,692,715	57 6
Latin America	115,309	140,756	42 3	423,497	.....	4,144,892	17,995,828	64 3
Pacific	37,864	135,407	69 1	1,539,981	.....	3,840,941	19,404,295	61 7
Panagra	9,995	16,699	54 1	73,807	.....	539,202	2,416,641	53 1
Resort[1]	.....	.....	.....	.....	.....	.....	.....	.....
Trans Caribbean[1]	.....	.....	.....	.....	.....	.....	.....	.....
Trans World	43,348	136,923	64 1	1,416,242	.....	1,468,964	16,916,807	60 0
United	24,488	60,898	78 2	291,449	11,308	207,671	6,674,093	69 4
Western	4,060	6,314	56 8	8,240	.....	24,024	688,542	58 9
LOCAL SERVICE								
Allegheny	66,594	13,179	42 5	16,898	30,923	45,496	1,350,936	43 3
Bonanza	23,114	5,691	38 3	8,118	3,950	10,269	565,166	39 2
Central	16,127	3,085	41 2	9,370	4,837	12,903	322,372	37 6
Frontier	32,875	8,892	43 6	26,194	10,712	68,635	963,995	47 8
Lake Central	18,649	3,012	36 2	5,205	19,612	.....	312,879	39 8
Mohawk	55,758	11,551	44 2	16,287	19,487	20,290	1,157,519	41 1
North Central	94,267	17,223	48 38	41,159	52,785	47,835	1,810,288	49 50
Ozark	51,364	9,030	39 7	18,334	29,882	31,705	942,911	43 4
Pacific	48,443	11,093	56 1	18,106	5,225	11,099	1,092,169	50 4
Piedmont	45,355	9,472	49 5	14,460	14,198	21,716	961,530	50 9
Southern	14,894	2,728	36 3	11,066	7,053	8,994	288,799	38 3
Trans Texas[1]	.....	.....	.....	.....	.....	.....	.....	.....
West Coast	38,296	9,040	48 62	15,090	6,366	25,385	190,203	48 95
HAWAIIAN								
Aloha	46,153	6,922	69 6	2,889	.....	6,960	564,861	58 9
Hawaiian	60,239	11,876	68 3	11,522	.....	197,460	1,200,968	64 3
CARGO LINES								
AAXICO[2]	.....	.....	.....	.....	.....	.....	.....	.....
Aerovias Sud Americana	.....	.....	.....	.....	.....	440,533	440,533	79 2
Flying Tiger	4,216	9,895	83 2	35,048	52,589	8,501,331	9,578,547	70 6
Riddle-Domestic[1]	.....	.....	.....	.....	.....	.....	.....	.....
Overseas[1]	.....	.....	.....	.....	.....	.....	.....	.....
Seaboard & Western	2,718	10,579	100 0	929,861	.....	3,639,183	5,365,652	73 0
Slick[1]	.....	.....	.....	.....	.....	.....	.....	.....
HELICOPTER LINES								
Chicago Helicopter	25,001	416	40 3	1,297	.....	.....	41,064	33 8
Los Angeles Airways	4,769	161	60 8	5,178	2,447	.....	23,020	69 7
New York Airways	13,179	260	54 6	1,350	708	514	27,643	53 0
ALASKA LINES								
Alaska Airlines	13,202	10,971	54 5	77,150	4,410	429,504	1,594,955	58 9
Alaska Coastal	9,081	852	57 7	3,686	.....	6,827	96,655	56 6
Cordova	2,120	368	45 2	5,624	.....	67,938	111,459	54 7
Ellis	7,516	466	54 7	2,606	.....	4,066	53,790	63 2
Northern Consolidated	4,465	1,415	53 9	40,723	.....	73,644	267,538	67 1
Pacific Northern	15,990	16,080	67 1	124,139	8,904	382,692	2,256,393	76 7
Reeve Aleutian	2,131	1,834	54 4	55,753	.....	93,711	349,645	69 6
Western Alaska	1,173	70	101 0	773	.....	1,753	9,160	66 7
Wien Alaska	8,414	2,496	75 5	53,752	.....	173,869	482,322	61 2
Avalon Air Transport	21,066	809,518	59 2	778	.....	1,098	78,780	60 7

[1] Not Available. [2] No Operations this month. [3] 30 Day extension due to destruction of records by fire.

Compiled by AVIATION WEEK from airline Form 41 reports to the Civil Aeronautics Board.

NEW "QUICK PUNCH" FOR MARINE ASSAULT MISSIONS

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Equally adaptable to Marine and/or Navy operations, this all-weather helicopter can perform missions ranging from ASW and mine-sweeping to ship-to-ship transfer. This adaptability, together with all-around superior performance, make the YHC-1A the most advanced helicopter in the air — a logical transport for the fighting Marines.

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AIRLINE OBSERVER

► Domestic trunkline coach traffic in September increased 15% over the same month in 1959 to maintain its slight edge over first-class revenue passenger miles, which dropped 10% in the same period. Coach traffic accounted for 50.8% of all traffic handled by the trunklines, a drop from the 54% recorded in August, but it marked the fourth consecutive month coach business has represented more than half the revenue passenger miles generated by the industry. Total domestic revenue passenger miles showed a 1.2% increase in September, while available seat miles rose 4.3% in the same period to cause a 1.84 point drop in the over-all load factor. Although first class available seat miles were reduced 5% during the month, first class load factors fell 3.21 points to continue a trend that began in October, 1959. Coach available seat miles climbed 16%, resulting in an 0.86 point dip in coach load factors.

► **Aeroflot officials list the price of the Russian Tu-104 twin turbojet transport at eight million rubles, according to officials in the U. S. aviation mission which recently returned from a three-week inspection of Soviet airline operations (AW Oct. 10, p. 37). At the official rate of exchange of four rubles to the U. S. dollar, this would be about $2 million. At the tourist rate of 10-1 it would equal $800,000.**

► Quebecair, Inc., of Canada credits much of its success in combating a two-month pilot strike to its Convair 540 equipment and the availability of non-union pilots. Present pilot complement of the airline includes 14 of the strikers who have returned to work, plus 16 non-union pilots hired on the basis of more than 100 applications submitted to the company. Higher pay scale for pilots of Convair equipment may have influenced the return of many strikers, Quebecair said. Company says the strike, termed illegal by the Ministry of Labor, was called after the airline and union failed to agree on wage scales.

► **British Overseas Airways Corp. showed a 50% increase in traffic on transatlantic routes during the first 10 days of October over the same period last year. BOAC officials attribute the increase to the 17-day excursion fares which came into effect Oct 1.**

► Panair of Brazil will buy two Douglas DC-8 transports powered by Pratt & Whitney JT4A-12 turbojet engines with a $13.8 million loan from the Export-Import Bank. Of the total $20.2 million cost of the new airplanes, plus spares and equipment, $4 million will be paid by Panair on delivery later this year and $2.4 million will be financed by Douglas.

► **Russian workers assigned to housing near the ends of airport runways are demanding that the government either curb the noise of aircraft engines or find noise victims another place to live. The Soviet trade union newspaper Trud reports a rash of protests against the "continuous roar of airplane motors warming up from the very earliest hours of the morning until late at night." Complaints from Moscow and Kuibyshev have been particularly vehement. Two Kuibyshev citizens recently wrote Trud that they were willing to tolerate loud airport noise as long as there was a critical shortage of housing. But now, with so much new construction going on, they say it's up to the authorities to "resettle" them in a quieter district.**

► Cunard Eagle Airways has started through, one-plane service from Miami to London via Nassau and Bermuda with one round trip flight every two weeks using a Bristol Britannia. The airline is operating the service under the authority of a U. S. foreign air carrier permit granted to Eagle Airways (Bermuda), Ltd., and/or Eagle Airways (Bahamas) covering the Miami-Nassau leg of the route but has requested permission from the Civil Aeronautics Board to use the name Cunard Eagle. Carrier must make the en route stops at Nassau or Bermuda on the transatlantic flights since the Nassau-Bermuda segment of the route is served under British authority.

► **Iberia Air Lines of Spain has ordered a fleet of four Sud Caravelle turbojet transports. The airline will look to the Spanish government for financing of the planes. Delivery of the first aircraft is slated for early 1962.**

SHORTLINES

► **Braniff Airways** is scheduled to begin international service from Minneapolis/St. Paul, Kansas City, Dallas and San Antonio to Mexico City Nov. 9. The daily flights will be made with mixed class Lockheed Electra airliners.

► **Capital Airlines** will begin Boeing 720 service Jan. 8 between Cleveland and Miami and Pittsburgh and Miami with daily nonstop schedules. Boeing 720 transports will be leased from United Air Lines.

► **Chicago Helicopter Airways** reports it has carried 237,537 passengers during the first nine months of 1960, compared with 142,867 for the same period last year. The helicopter carrier carried its 600,000th passenger Sept. 28 and expects to carry its millionth passenger sometime before its fifth anniversary as a scheduled passenger carrier, Nov. 12, 1961.

► **Civil Aeronautics Board** has set Nov. 1 as the hearing date on repeal of economic regulations pertaining to blanket exemptions for carrying military contract passengers and cargo.

► **Eastern Air Lines** has started a five week training course in Mexico for personnel of Aeronaves de Mexico under the agreement signed recently by the two carriers. Eastern will train Aeronaves' chief pilot, five line captains, 10 pilots and a senior flight dispatch officer on the staff of the Mexican Civil Aviation Administration. The training course will cover DC-8 operations and include substantial time in Eastern's DC-8 simulator.

► **Mohawk Airlines'** authority to serve its temporary Syracuse-New York nonstop route would be extended indefinitely under a Civil Aeronautics Board show cause order. The Board was impressed with Mohawk's showing on the nonstop route, especially since the local service airline was operating in direct competition with a trunk carrier, American Airlines.

► **Trans World Airlines** has received CAB permission to suspend its polar route service from Los Angeles and San Francisco to Europe between Oct. 30 and Apr. 1, 1961. Like Pan American World Airways, TWA asked for suspension because the drop in passenger travel to Europe during the winter months makes it uneconomical to operate the polar route while the airline offers substantial service across the Atlantic from New York (AW Oct. 10, p. 52).

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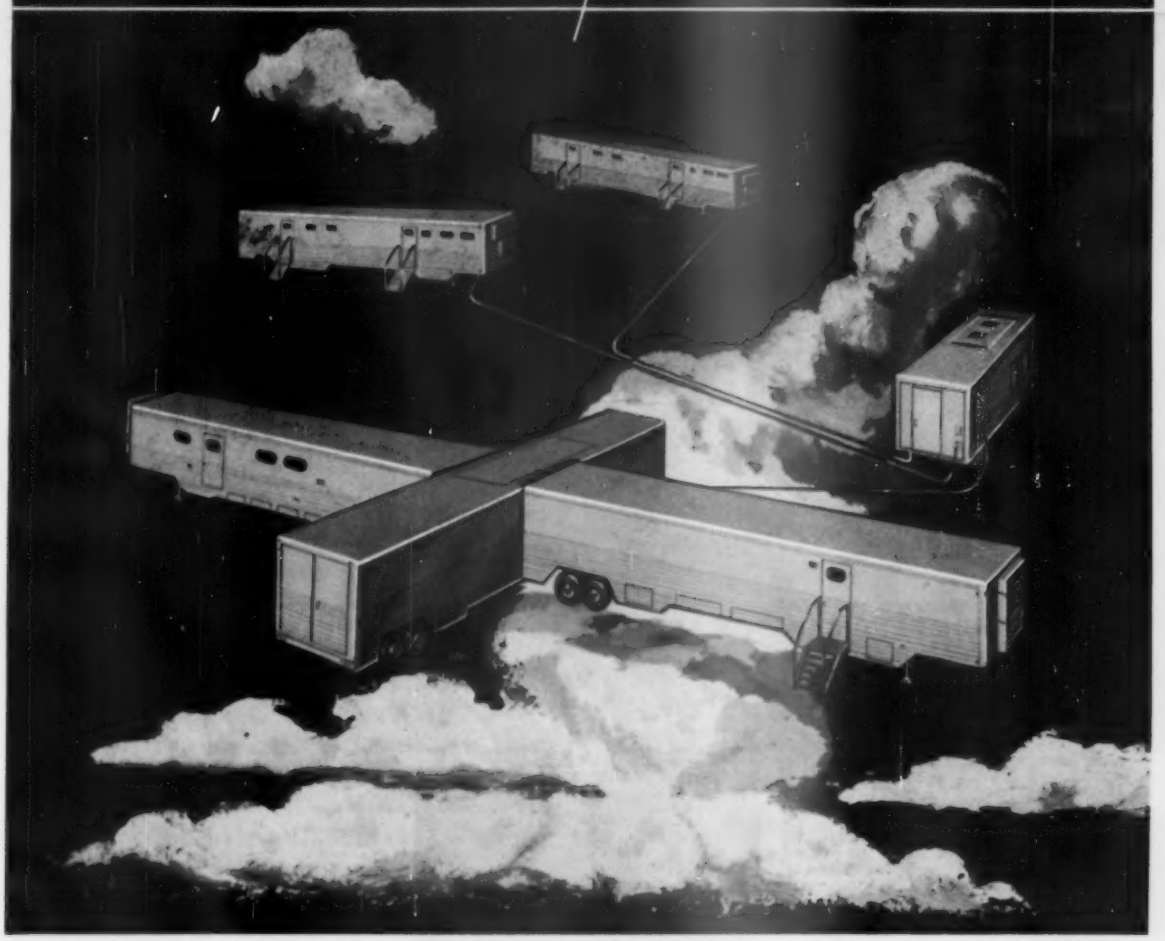


Bio-medical complex by Condec is all this, and more

Hospital, altitude chamber, machine shop, data processing center, biological laboratories, generating station . . . Condec's bio-medical complex for the Discoverer satellite program is all of these things.

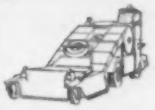
Consisting of six vans, the complex operates as a single system with the flexibility of detaching any one van to perform its own function without support of other units.

Biological laboratories house the animal specimens for pre-flight conditioning; workshop is completely equipped for pre-launch capsule assembly and repairs; the altitude chamber simulates altitudes to 200,000 feet, and reaches it in 10 minutes; instrumentation van contains data processing, recording and analysis system; power van supplies 150 kilowatts from a Condec generator.

If you think this suggests that the Aircraft Equipment Division of Consolidated Diesel has unusual capabilities, you're right. It has the problem-solving approach and facilities to find more effective ways of doing old jobs, to create new methods of solving fundamental problems. For more information on the benefits you can get from Consolidated Diesel, write or telephone Mr. Jerome I. Davis, Vice President, Aircraft Equipment Division.

Condec Products for Ground Support

Mobile shelters go anywhere by land, sea or air with electronic maintenance equipment. Air-conditioned. Insulated. Heated. Less than 3,500 pounds, equipped.



Special Purpose Vehicles designed for any ground support requirement for modern aircraft and missiles. Runway sweepers save millions of dollars annually in jet engine maintenance.

Test equipment ranges from simple portable benches to complex fixed installations for checking hydraulic, pneumatic, electrical, and mechanical operating parameters.

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POINTS OF DEPARTURE

THE STROMBERG-CARLSON SYSTEMS MANAGEMENT TEAM HEADS...???

We can't give you the details yet, but we can report that Stromberg-Carlson has been asked to head up the development program for a passive reconnaissance network. Stromberg-Carlson won the nod on the strength of its Core Concept of Systems management, which helped get the project off and winging in short order . . . and on its long-standing sophistication in all aspects of advanced electronics and communications, military and commercial.

in SYSTEMS MANAGEMENT:

We're ready to launch your project as well—*now*. Because Core Concept maintains a permanent staff of top scientists, engineers, technicians, cost-scheduling and managerial talent, Stromberg-Carlson is always tooled up for any problems that arise within the rather extensive perimeters of its competence. Seasoned and dynamic, the Core Concept staff can line up contributing sub-contractor firms and get well underway on system projects of all types—in the time it previously took just to assemble a systems management group.

There's a very simple yardstick for measuring the speed and efficiency of Core Concept. Money. It's expected that Core Concept organization and administration can cut systems management cost significantly.

In what areas are we qualified? Well, we're involved in radar development for missile tracking systems. We've achieved several breakthroughs in solid-state circuitry and modularization of computer systems. We've had over 65 years in every phase of telephone communications. We produce radio sending and receiving equipment for land, sea, air and space. And we're right up there in high-speed teleprinters and electronic display techniques. Look on Stromberg-Carlson as a supermarket for systems, ideas and talent—to serve you.

FISHING FOR SUBMARINES . . . FROM THE AIR. SOME NEW IDEAS FROM S. C.

Efficient detection of underseas targets from swift-ranging aircraft will require new non-acoustic techniques. Stromberg-Carlson scientists think that a research program now in progress has important applications to these techniques. Under investigation are low-frequency electromagnetic phenomena, interplanetary plasma physics, and other geophysical processes which produce electromagnetic "noise."

in COMMUNICATIONS RESEARCH:

In present non-acoustic methods of detection from the air, the signal strength is frequently weak and always decays rapidly with distance; it soon disappears in the ever-present background noise.

Already, several signal processing techniques resulting from Stromberg-Carlson noise studies have been developed and tested. These show performance gains which promise to offset partially the loss in signal with distance through more effective discrimination against background noise.

The investigation of geophysical and astrophysical phenomena will include study of electromagnetic background noise at the earth's surface in the frequency region of 0.001 to 10,000 cps, solar radio signals and the interplanetary medium. Knowledge in this field of interest is growing rapidly, and worthwhile scientific contributions resulting from the planned work are almost certain.

In the course of investigation, Stromberg-Carlson scientists also propose to determine the relationship between the characteristics of the earth's surface and the low-frequency electromagnetic background and to examine the noise spectrum for types of signals hitherto unknown.

This program is only one of Stromberg-Carlson's numerous basic research projects currently underway in all areas of electronics and communications.

FOR NUCLEAR REACTORS . . . MORE HOURS OF POWER EVERY MONTH

With Stromberg-Carlson's new completely solid-state modularized control systems, nuclear reactors put in significantly more operating hours every month.

While attending to their main functions—monitoring and controlling power level, rate of change of power level, pressure, temperature, and coolant flow—Stromberg-Carlson control systems check themselves continuously. Malfunctions are rare, but if one occurs, scram rods drop and the address of the offending part is flashed on the annunciator. Even an unskilled operator can then pull the module containing the flaw and plug in a replacement—all in a matter of minutes. Previously, it took hours, even days, to get a nuclear reactor back into operation.

in ELECTRONIC EQUIPMENT:

But this is merely the spectacular phase. More mundane, but more to the point in reducing reactor down time, is the simple fact that malfunctions *are* so rare.

We achieve a unique degree of reliability through 100% use of transistors and key-point use of solid-state relays. In addition to reliability, solid-state circuits give greater protection against shock and vibration, need less power, produce a much more compact unit. And, most importantly, we reach a new plateau in fail-safe operation.

Right now, Stromberg-Carlson control systems are used with Detroit Edison's Enrico Fermi reactor . . . and will handle the Army's Ice Cap reactor — a portable, skid-mounted unit that will feed power to a Dew Line station in Greenland.

Stromberg-Carlson systems provide instrumentation throughout a reactor's entire operating range, from the moment of start-up. An overlap of two decades in the source, intermediate and power ranges assures continuous monitoring. Light and compact, these systems can control marine, portable, research, or commercial reactors.

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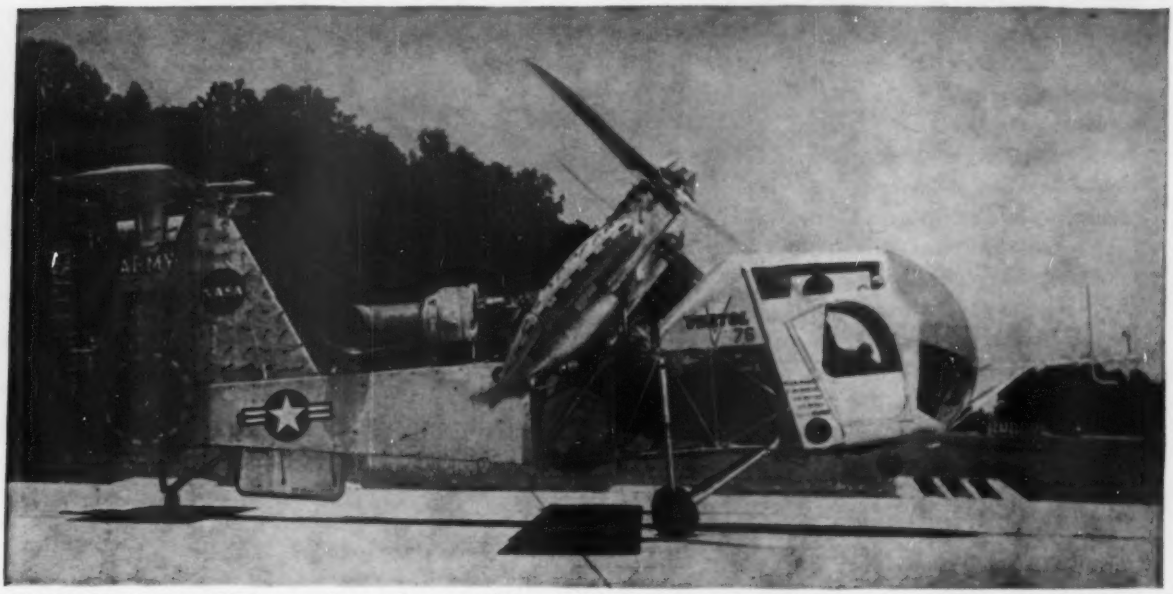


VERTOL 76 tilt-wing VTOL research aircraft, powered by single Lycoming T53 free-turbine engine, was evaluated by NASA pilots during one-year program of flight tests. Changes made in configuration by NASA included extra dorsal and ventral fin area, and closed rear fuselage. Wing position is shown set for short takeoff and landing performance. Wool tufts taped to vertical tail and wing surfaces provide visual qualitative indication of airflow patterns.

Vertol 76 Enters Modification Program

By David A. Anderton

Morton, Pa.—Vertol Model 76 tilt-wing VTOL, which completed flight evaluation last month, now enters a modification program reflecting state-of-the-art improvements in control and performance characteristics.

Planned changes are in negotiation on proposal stages between Vertol Division of Boeing Airplane Co. and the U. S. Army, sponsor of the Model 76 project. These changes originated during the three-year flight-testing of the research vehicle, aimed at proving the concepts of the tilt-wing design in the quickest and cheapest way possible.

Modifications are minor; they will be made in stages and may or may not stay on the aircraft. They are slated to include:

- **Split ailerons** divided in a spanwise sense, for more-powerful yaw control when the wing is tilted.
- **Simplified cyclic control** around the pitch axis.
- **Full-span ailerons** to improve lateral control during airplane-phase flights of the Model 76.
- **Two-segment flap** to increase both effective wing area and available maximum lift coefficient.

Variety of Changes

Already a different-looking configuration from what it was when its flying started, the Vertol 76 shows a variety of changes made by the company and by technicians of the National Aeronautics and Space Administration. Vertol installed a ground-level Martin-Baker ejection seat for the pilot after early flight-testing was under way, and changed the windshield—a Bell helicopter bubble—to fit the form of the seat. NASA added extra dorsal and ventral fin area and closed the sides of the open-truss fuselage.

Most recent of the NASA changes was a droop-snoot leading edge worked up from balsa wood and glass fiber cloth. This was intended to be a quick-and-dirty fix for loss of roll stability in a reduced power descent with the tilt-wing set at angles approximating 30 deg. As the slipstream velocity dropped, the wing angle of attack increased, and the surface approached a stalled condition, making much more work for the pilot. Vertol was considering fixed slots on the wing as a cure, but NASA found the simpler leading-edge modification adequate.

NASA's evaluation work with the design, done on behalf of the Army which has no evaluation pilots of its own, ended early last month. At that

Vertol 76 Weights and Dimensions

Gross weight	3,200 lb.
Weight empty	2,500 lb.
Wing span	24 ft. 11 in.
Length	26 ft. 5 in.
Height	10 ft. 0 in.
Rotor-prop diameter	9 ft. 6 in.
Tail fan diameter	2 ft. 0 in.
Wing area	110 sq. ft.
Wing airfoil	NACA 4415 (modified)

VTOL Future

Biggest future market for VTOL aircraft is the executive and business aircraft field, says W. Z. Stepniewski, Vertol's chief of research.

Speed range of such aircraft, better than that of the helicopter but below that of long-range transports, makes it fit the short-haul runs. Takeoff and landing performance enables the VTOL craft to work out of helicopter-sized fields, and its noise level—between that of a light airplane and a helicopter of comparable powers—adds to its attractiveness for operations in urban areas.

Vertol 76 represents one basic concept which can be expanded into such an economical and safe transport, Stepniewski says. Its place lies above helicopters and compound aircraft where range and speed are more important than hovering efficiency.

VERTOL 76 in low-speed forward flight regime shows its early configuration before company and NASA changes.

time the Vertol 76 had a total of 50 hr. flight time, of which 20 were under the NASA program. The airframe, subjected to considerable static and dynamic ground testing before it ever flew, now has a total between 600 and 800 hr. time.

Eleven pilots with either fixed-wing or helicopter experience, or both, have flown the tilt-wing design, and have made the conversion to type in a matter of minutes. One pilot started his conversion training with an "STOL takeoff"—a short takeoff with the wing in tilted position. None of the pilots has reported any trouble in making the switch to the unusual vehicle.

Basically a Testbed

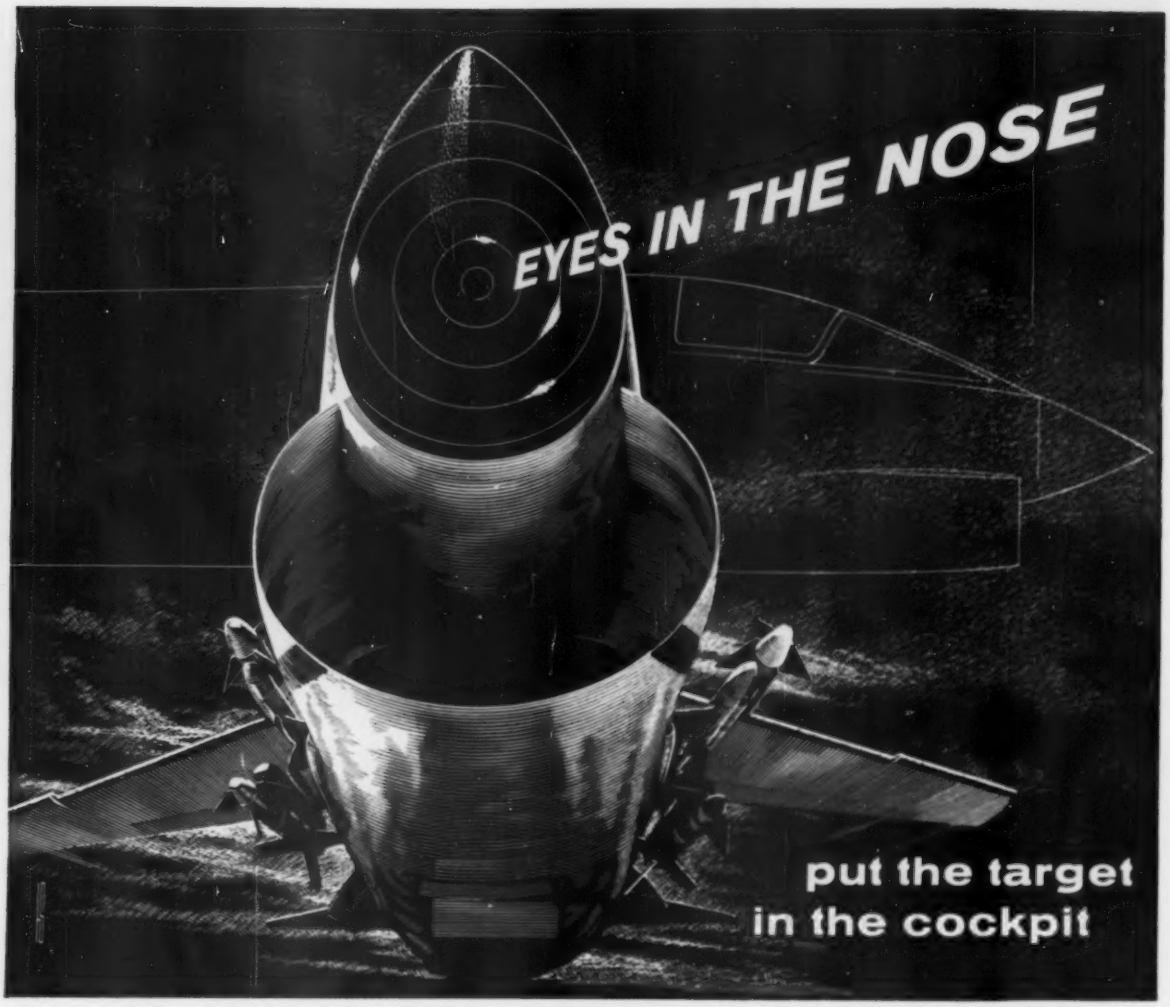
Flying the Model 76 combines fixed-wing and helicopter skills, and requires a cockpit layout tailored to this combined requirement. The basic vehicle is a testbed, designed for the sole purpose of proving the tilt-wing scheme, and consequently is a simplified airframe-engine combination.

The tilt-wing consists of a conventional wing of reasonable area, mounted so that its incidence can be varied through 90 deg. with respect to the fuselage center line. Two rotor-propellers are mounted in fairings on the wing, fixed to move with the wing.

A single Lycoming T53 free-turbine engine drives the rotor-propellers through shafting to provide thrust which can be vectored to produce combinations between all thrust and all lift.

Power is supplied to a pair of fans at the tail, one mounted to control yaw motion and the other to control pitch. Conventional aerodynamic surfaces are installed to handle control during flight of the Model 76 as an airplane; the fans control the pitch and the yaw of the vehicle during vertical or low-speed flight regimes. Roll control in low-speed flight is done with differential

SHORT TAKEOFF performance of Vertol 76 enables the testbed aircraft to get off the ground with a run of about two fuselage lengths. Variable wing position allows anything from vertical liftoff to normal takeoff run along a paved runway surface.



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This airborne radar system is just one of many systems which have been and are being designed and produced to satisfy the tactical requirements of the military services in the fields of Communications, Airborne Radar, ASW, Navigation, Fusing and Data Handling.

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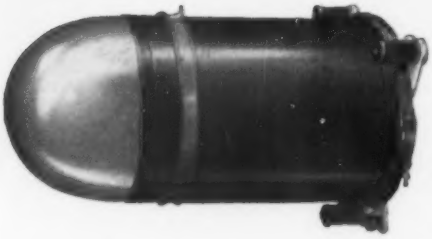

AIRBORNE FIRE CONTROL RADAR

COMMUNICATIONS	RADAR	DATA HANDLING	ASW	MISSILES

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collective pitch on the rotor-props.

Cockpit layout resembles a conventional helicopter position, with cyclic stick mounted in the center, collective pitch lever at the pilot's left, and rudder pedals. Wing tilt is controlled with a thumb switch on top of the cyclic stick, like a standard trim switch. Pushing the switch forward drops the nose of the wing toward the zero-incidence position, and pulling back on the switch raises the wing toward the vertical.

Full transition from horizontal wing position to vertical takes a minimum of about 10 sec.

Control System

Control system operates through three phases in three different ways:

• **Hovering phase,** with vertical motion controlled by collective pitch of the main rotor-propellers. In this configuration, which uses the wing tilted vertically and therefore places the rotor-props in a horizontal plane, roll control comes from differential collective pitch imposed on the rotor-props by lateral motion of the cyclic stick. Reversed aileron deflection, initiated by the lateral motion of the stick, balances out the yawing moment created by differential slipstream velocity on the tilted wing. Pitch and yaw control comes from blade angle changes on the appropriate fans, initiated by the fore-and-aft motion of the cyclic stick in pitch and the rudder pedals in yaw.

• **Conversion phase,** which occurs between the hovering attitude and the time the aircraft is airborne on wing lift alone. The differential collective pitch fades out in favor of aileron power, which reverses itself from the hovering sense and acts normally. Yaw and pitch controls remain in the fans, with aerodynamic surfaces becoming increasingly effective as forward speed increases.

• **Airplane phase** when the aircraft is fully wing-borne. The collective pitch lever becomes a propeller pitch change lever in forward flight, roll control is solely on the ailerons, and pitch and yaw come from both fans and aerodynamic surfaces.

Flying Routine

After completing the prestart check list, the pilot starts the engine and selects the engine speed. When the engine is up to speed and he has checked the instrumentation, he runs the wing up to the vertical position, increases the collective pitch on both the rotor-props and the Model 76 rises vertically.

He starts transition with the thumb switch, pressing it forward to drop the nose of the wing. The rate of change is proportional to the deflection of the switch. As the nose drops, and the aircraft begins to fly forward, the control linkages are automatically modified, so that differential collective pitch fades

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Each of the basic models illustrated at the right is representative of a series of similar units which vary only in output characteristics. They are available and were developed to satisfy a special requirement but can now be considered as standard production items...completely tooled, qualified, proved in actual use ...ready for immediate order.

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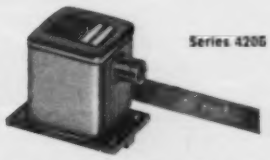
Smallest and newest addition to Pacific's line—it delivers 2% accuracy over a —10 to +30G range. Features silicon fluid damping for unsurpassed shock and vibration immunity. Overall size 1.1"W x 1.5"L x .8"D. Potentiometer pick-off.



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For Increased Accuracy to 1% or less under rugged environmental conditions. Originally designed for use in an anti-missile missile, this unit features temperature compensated damping mechanism using silicon fluid.

Series 4201

Light and little ... This miniature accelerometer is a versatile, high production instrument with unusual flexibility of design and performance characteristics. Maintains accurate signals thru long service life. Potentiometer pick-off.

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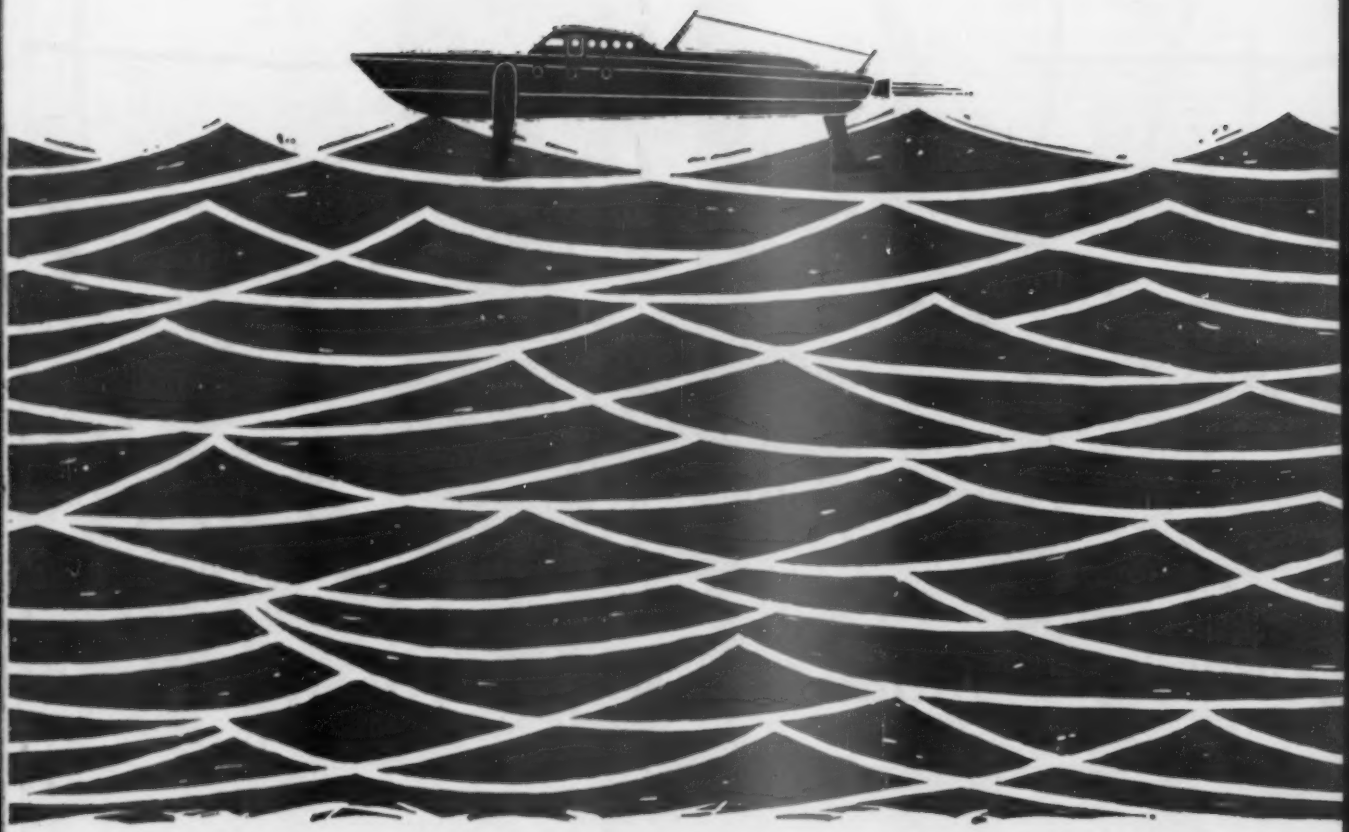

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SEABORNE: Present research includes thorough investigation of the aspects of seaborne ASW. "Seaborne" is a very large term, and we mean every area of it: undersea, surface ship, hydrofoil. Useful in submarines themselves are some of the navigational equipments we have designed. For cruisers and destroyers, advanced computing and plotting systems are proposed. And for hydrofoils, which are analogous to low-flying aircraft, we are studying a complete adaptation of our operational airborne ASW weapons system. This will be comprised of navigational, target plotting and computing equipments capable of handling many tracks and targets simultaneously. Because of the high speed projected for the hydrofoil vehicle, the entire tactical system must have instantaneous response and great accuracy, the same as that for aircraft. —■— These are a few research projects that will result in new systems here . . . where the key letters in "hardware" are "R" and "D." If you are a senior scientist or engineer with interests in plotting other approaches to ASW, write LORAL Electronics Corporation, New York 72, N. Y.

Regional Engineering Offices: Boston, Massachusetts; Dayton, Ohio; Tustin, California; Washington, D. C.

In early 1960, American craft pierced the North Pole in two elements. Fathoms below solid ice, the USS Sargo probed unerringly to "90 North"; miles above, a GAM-77 missile on a B-52 pinpointed the featureless goal. Both used Inertial Navigation systems by Autonetics—where today's results pave the way for tomorrow's breakthroughs.

Electromechanical Systems by **Autonetics** Division of North American Aviation

out, and ailerons strengthen. By the time the wing is full down, all roll comes from the ailerons.

The procedure is reversed for making the transition back from wing-borne to rotor-borne flight.

Since the initial transition flight in July, 1958, about 200 more conversions have been made from hovering to forward flight and back again. More than 30 of these conversions were complete cycles. Out of 800 takeoffs and landings, about 200 were in the STOL category.

Stability Augmentation

The Vertol 76 has been flown with and without stability augmentation systems; but they make hovering much easier for the pilot. In transition and forward flight with the wing at less than 45 deg. angle, no stability augmentation is needed.

Basic idea of a fast-moving test development program built around a simple and cheap flying testbed originated in 1955 with W. Z. Stepniewski, Vertol's chief of research. One of the first approaches was a design using a French Turbomeca Artouste rated at 396 eshp., in a vehicle weighing about 1,930 lb. But availability of the larger Lycoming T53, derated to 600 eshp. for the job, dictated the final design of the Vertol 76.

Vertol got the contract on Apr. 15, 1956, sponsored by the Army and coordinated through the Office of Naval Research, an agency which has long spearheaded the drive for vertical flight. In 11½ months the Model 76 was rolled out of the hangar, and at that point, had a total program cost of $840,000.

Paul Dancik, who is project engineer for VTOL, said that he had between 20 and 30 men working on the design of the vehicle and on parallel investigations of rotor, systems, model tests and the like. To save money and time, Dancik's team specified available parts: a Bell helicopter bubble for the cockpit canopy, wing-tilt actuators from the

Canopy Shelters F-105D Technicians

Canopy of corrugated glass fiber shelters technicians at Republic Aircraft's Farmingdale, N. Y. plant as they test electronic systems of the F-105D fighter-bomber.

PUMP PRIMERS

ARTHUR A. NICHOLS

HIGH PUMP RELIABILITY IN SEVERE ENVIRONMENTS

► Engineers concerned with drives, auxiliary power sources, gear boxes and various transmission design problems involving pressure lubrication have found Gerotor type pumps extremely useful in their attempts to hold weight down and achieve maximum compactness with high service reliability.

► **The Gerotor is a form of internal gear pump consisting of only two moving parts: an inner toothed element and an outer, meshing toothed element. The inner element has one less tooth than the outer and the "missing tooth" provides a chamber to move the fluid from the inlet port to the outlet. (See Figure 1). Pump capacity is measured by the volume of the "missing tooth" multiplied by the number of driver teeth and RPM.**

Fig. 1

► Low relative speed and closely held clearances between the two Gerotor elements mean high mechanical efficiency is maintained.

► **Slow opening of the chamber as it traverses the large inlet and discharge ports results in avoidance of the sudden shock, rapid pressure change and turbulence which, in other types of pumps, results in foaming and lowered efficiency. Thus, Gerotor pumps offer exceptionally good performance at high altitude.**

► Engineers find the Gerotor pump most attractive because there are several convenient variables that can be adjusted to meet the application requirements: Gerotor *diameter* which governs the area of the pumping chamber, Gerotor *thickness*, which, taken with area, determines *unit volume* per revolution and *RPM*. Thus, it is possible to vary the diameter, length and speed of the pump elements to secure wanted capacity. In addition, the porting of this type of pump is completely flexible in location, making for ease of fitting adaptability to the available space and geometry of the engine structure.

Fig. 2
Multiple Element Lube and Scavenge Pump

► *Technical data is available and your inquiry is invited. Write:*

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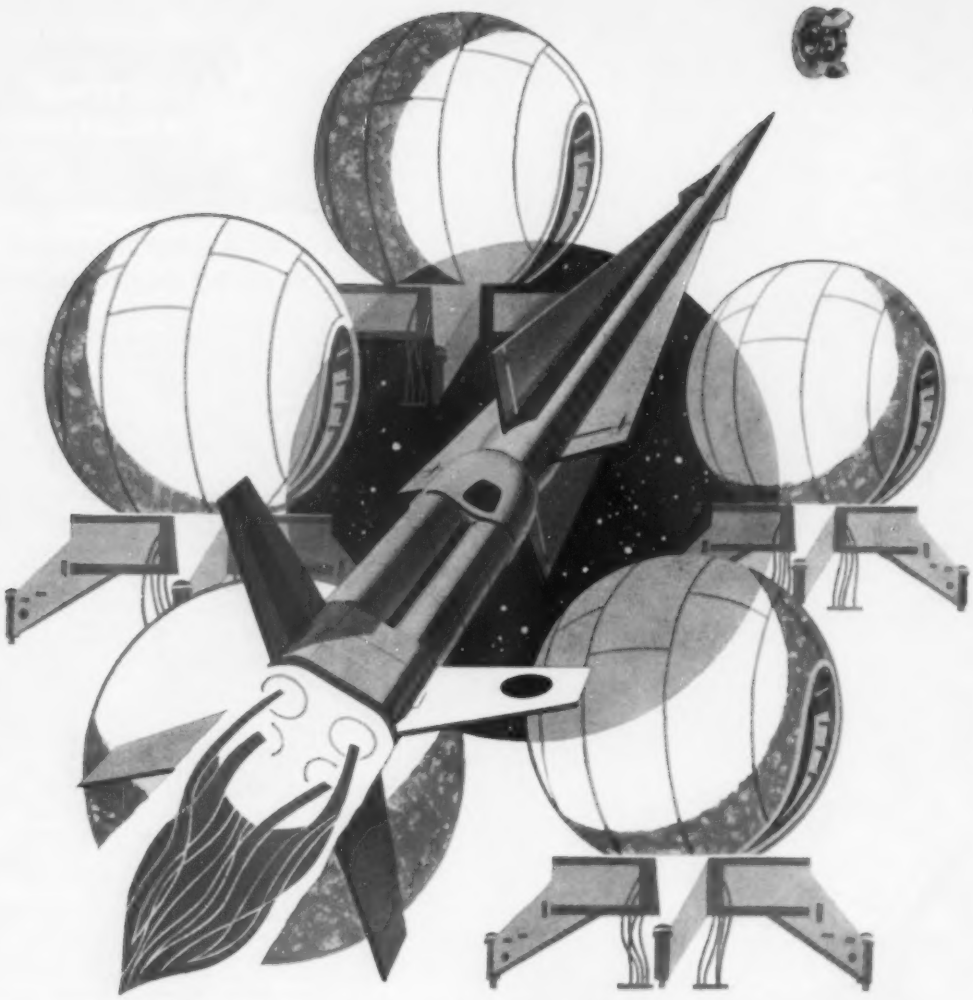

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ND Designs Assembly Savings Into Critical Miniature/Instrument Ball Bearings!

Helping customers *simplify* instrument assembly is a specialty of the N/D engineering group. How? Through *creative* Miniature/Instrument ball bearing application and design. Often, a new ball bearing design will produce assembly savings in excess of its additional costs. Integral ball bearings, too, very often cut down difficult and costly hand assembly of shaft and parts.

A timely example of N/D customer assembly savings can be seen in Nike Ajax and Hercules missile ground support. Here, *special* N/D Instrument ball bearings are now used in precision potentiometers. New Departure engineers recommended eliminating two *single* row instrument bearings, mounted in duplex and requiring precision spacer and separate guide roller. They replaced this assembly with a *special* N/D *double* row high precision instrument ball bearing with integral outer race guide roller . . . and shaft mounted with a nut. This *one* recommendation produced cost savings of over 400%! In turn, the customer was able to reduce the potentiometer selling price to the government. What's more, the New Departure Instrument Ball Bearings improved potentiometer reliability!

You can look to minimum assembly costs and unsurpassed *reliability*. Include an N/D Miniature/Instrument Bearing Specialist in your early design level discussions. For immediate information or assistance, call or write Department L.S., New Departure Division, General Motors Corporation, Bristol, Connecticut.

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MINIATURE & INSTRUMENT BALL BEARINGS
proved reliability you can build around

XH-16, an HUP tail oleo for the Model 76 main landing gear, and miscellaneous H-21 parts all contributed to the design. Parsons did the rotor-propeller blades because of their long and specific experience in that line, and Gleason did the gearing. Everything else was done at Vertol.

Leonard LaVassar, Vertol's pilot for the Model 76 tests, started the flight phase of the program with a short hovering run Aug. 13, 1957. After a few modifications required by the behavior of the aircraft during taxi runs and the hovering phase of flight, LaVassar made the first flight in an airplane configuration Jan. 7, 1958, in which the Vertol 76 took off and landed on a runway in the conventional manner.

First Conversion

First conversion from hovering to wing-borne flight took place on July 15, 1958, and to the watching Vertol engineers, this was the final proof of the program. From there on, the jobs were those of refinement and final development; the concept had been proven.

Company tests were finished Sept. 23, 1959, and the plane was sent to NASA for its evaluation which ended late in September this year.

"We've spent a million and a half dollars to prove the concept," said Dancik. "It took us about three years, which is about half a million dollars per year to keep the program going. I think it's a good return for the money."

Both Dancik and Stepniewski point out that half a million dollars goes a long way on a project of this sort. The Vertol team had been able to design and build a test vehicle within a time span of less than a year and at a low project cost. Further, the over-all program included parallel test and development work on the rotor-propellers and on free-flight and wind-tunnel models, and phased in continual changes or modifications that represented knowledge acquired along the way either at Vertol or elsewhere in the over-all VTOL/STOL programs.

Army's Move

Both engineers point out that currently there is a lull in the program. "We're finished except for these minor changes," says Stepniewski. "Now we've got to wait for the Army to make the next step."

The next step probably will be a study of NASA's evaluation of the Vertol 76 and other projects, hopefully followed by further development contracts for operational vehicles designed to a mission requirement. But much depends on the vagaries of budgeting for development work, and Vertol is not alone in wondering which way the trends will head.

Propellant Briefs from Callery Chemical Company

Diborane: Fuel for Rockets, Ramjets, Turbojets—Diborane (B_2H_6) is available in development quantities on a commercial basis and will be produced in tonnage quantities as the basic building block for pentaborane at the Callery-operated, government-owned Muskogee, Oklahoma plant.

Development quantities of up to four pounds are shipped from Callery, Pa. Insulating techniques used for shipment and storage insure maximum stability.

Write for technical bulletin C-202 and handling bulletin C-201.

Triethylborane: Effective Igniter and Fuel—Triethylborane $(C_2H_5)_3B$ is a fuel for ramjets and is used as an igniter for rocket and turbojet engines.

Write for TEB technical bulletin C-310, and TEB handling bulletin C-311.

Nitronium Perchlorate: (NO_2ClO_4) a solid oxidizer, is proving useful in various rocket system applications. Not shock sensitive when pure.

Write for bulletin C-1200.

Pentaborane (B_5H_9): New Fuel for Air Force—Potential of pentaborane as a fuel is illustrated by its high heat of combustion of 29,000 Btu/lb. and its high specific impulse. T. O. Dobbins in WADC TR 59-757 reports the following shifting equilibrium impulses for pentaborane:

Oxidizer	Isp 1000/14.7 Psia.	Isp 1000/.2 Psia.
OF_2	367	466
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O_2	327	421
NF_3	326	413
H_2O_2	316	399
ClO_3F	306	391
N_2O_4	306	390

Write for bulletin—Pentaborane C-3100.

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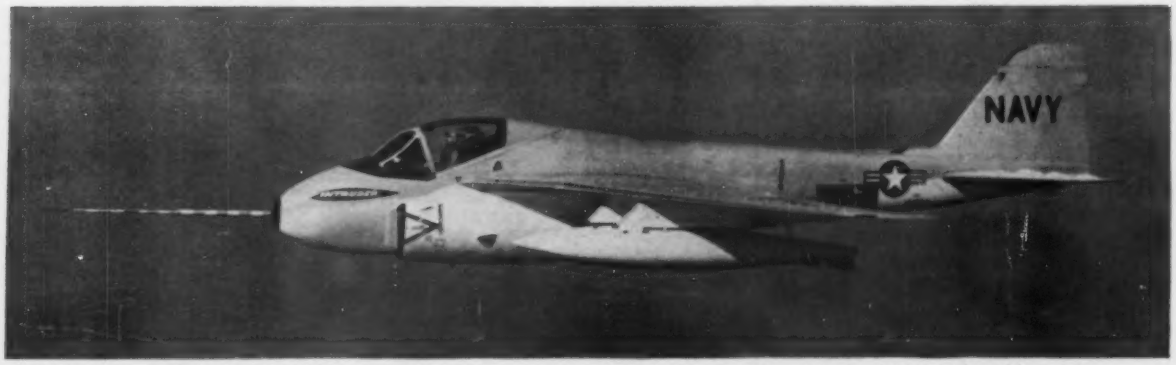
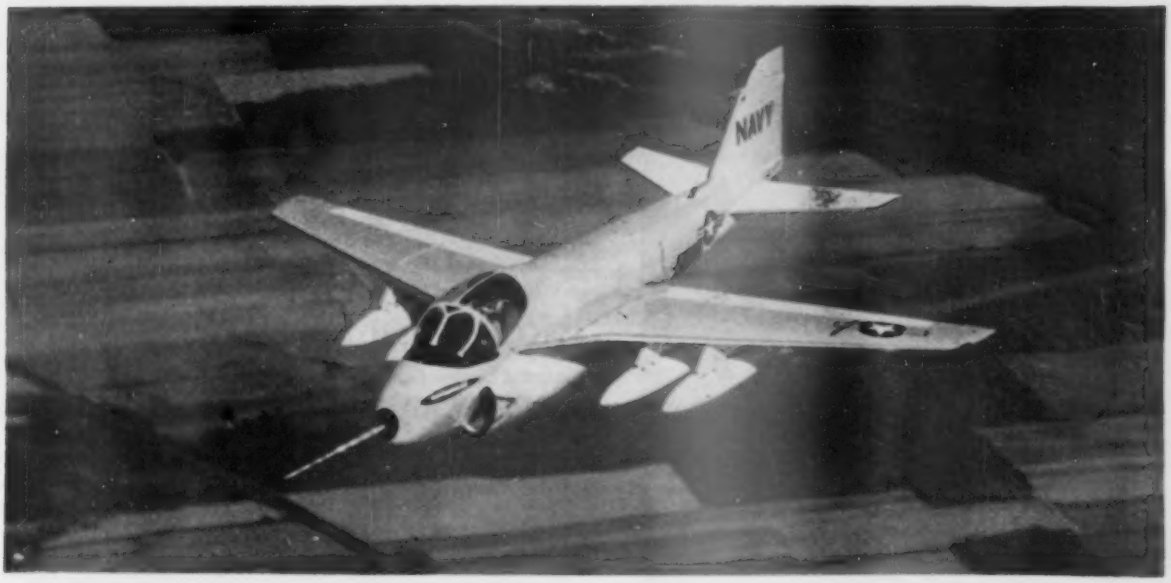
Grumman A2F-1 Intruder, a carrier-based low-level attack bomber capable of holding Mach .9 at sea level, is equipped with brazed honeycomb stainless steel speed brakes mounted behind jet exhausts. A2F-1 is powered by two Pratt & Whitney J52-P6 turbojets.

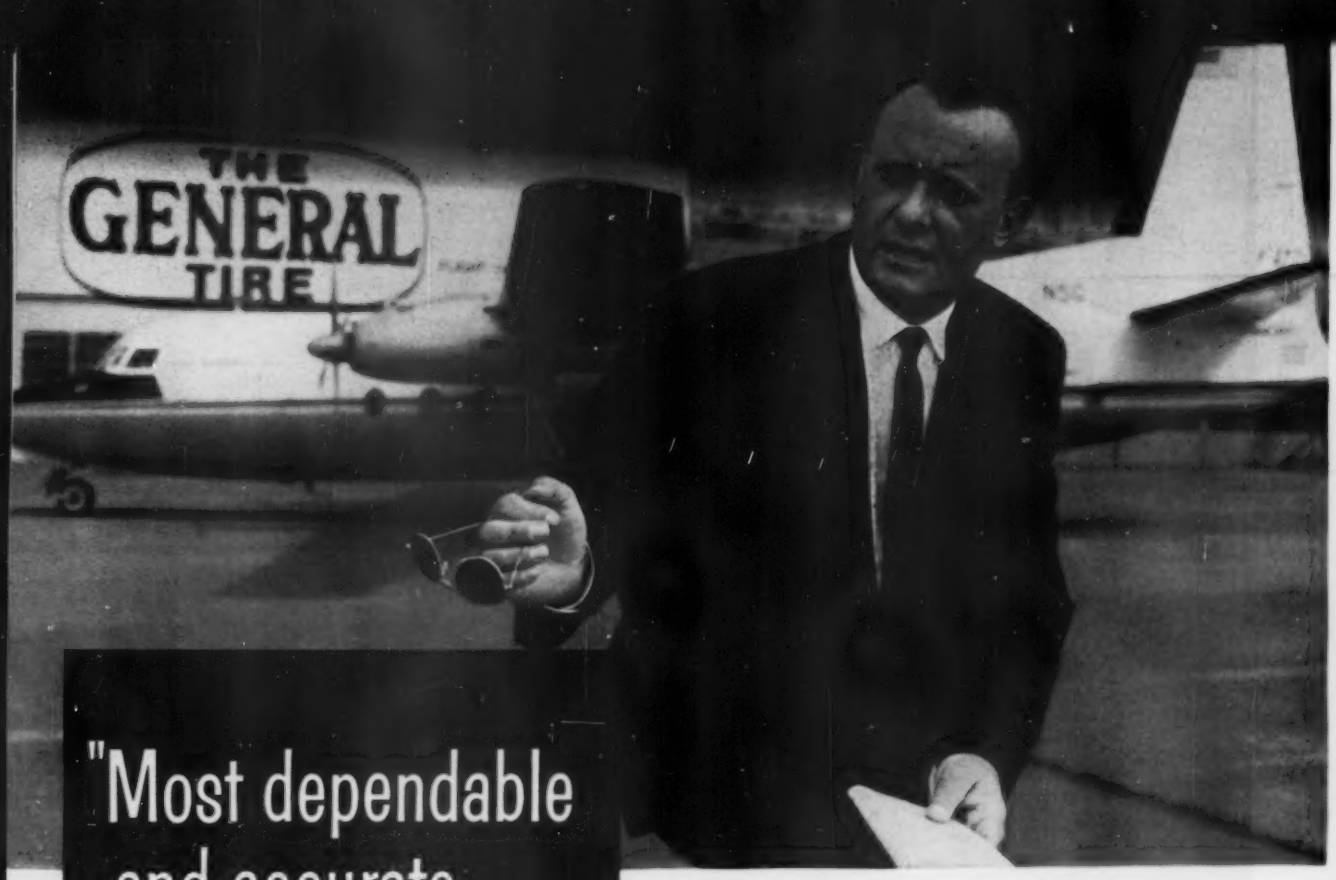
Adjustable Tailpipes on A2F-1 Give STOL Effect



A2F-1 has been stalled, clean, at 125 kt.; with power on, gear and flaps down aircraft has stalled at 80 kt. Adjustable tailpipes, manufactured by Ryan, are mounted 7 deg. down from wing chord line and can be lowered 23 deg. more to provide STOL effect on takeoff.

Side-by-side two-place Intruder above carries four 300-gal. auxiliary fuel tanks mounted on weapons stations for long duration missions. A2F-1 carried three Mk. 84, 2,000 lb. GP bombs mounted outboard on each wing and under belly, and two Martin ASM-7 Bullpups.





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If you're considering the purchase of an ADF system, it will pay you to talk to your local Bendix dealer about the DFA-70. For further information, or for the name of your closest dealer, contact Bendix Radio Division, Avionics Group, Baltimore 4, Maryland.

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NASA Reports Confirm 75,000 ft. U-2 Altitude

Washington—National Aeronautics and Space Administration reports now officially concede that the Lockheed U-2 aircraft flew at a top altitude of 75,000 ft. rather than 55,000 ft. during weather flights over Europe, Turkey, Japan and the U.S. from 1956 to 1958.

Three reports on these weather flights published by NASA and its predecessor, the National Advisory Committee for Aeronautics, in 1957 and 1959 indicated that atmospheric turbulence measurements were made in these areas at altitudes of 20,000 to 55,000 ft. Technical Note D-548, just published by NASA, amends these reports and adds turbulence data gathered in the altitude range of 60,000 to 75,000 ft. on the same series of flights.

New NASA report also describes the optimum method of operating the U-2. Climb to cruise altitude is made rapidly at rates varying from 5,000 fpm. to 2,000 fpm. Angle of attack is held constant during cruise, and altitude increases as fuel is burned off. At the end of the flight, the descent is made at the rate of 2,000 fpm.

Average duration of the weather flights was reported by NASA to be 6 hr. for those made from Del Rio, Tex., about 2.5 hr. for the European operations and 4 hr. for the other flights.

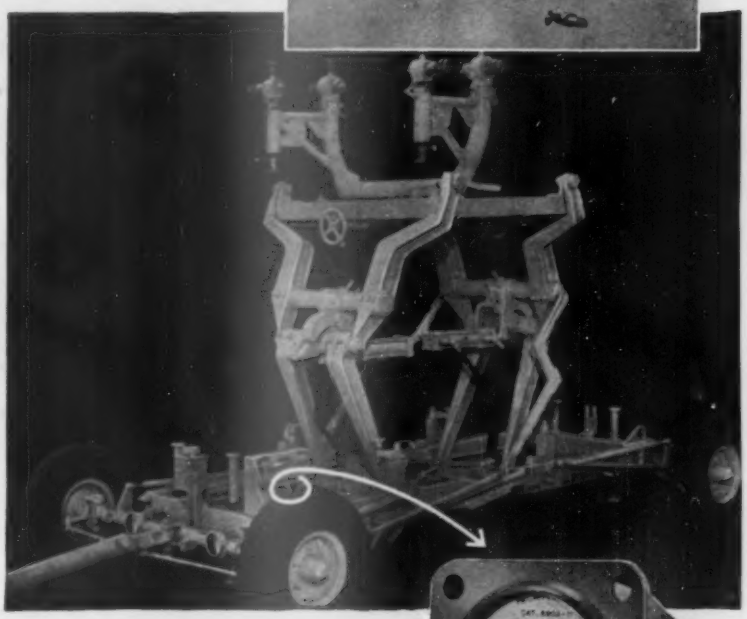
Total of 315,000 mi. was covered by the U-2 on 192 weather flights reported by NASA in TN-D-548. Included in this total are 35 flights covering 101,154 mi. made over the southern U.S. from November, 1958 to December, 1959 and not reported previously. Number of flights listed in the new report as being made over Europe, Turkey and Japan is the same total given previously. The total number of flight miles has been adjusted, however, and it is now 65,229 mi. higher. Presumably these miles were logged at altitudes between 60,000 and 75,000 ft.

Results of turbulence studies by the U-2 have provided valuable design data for the designers of B-70 and supersonic transports.

They show:

- **Turbulence** from 60,000 to 75,000 ft. is both less frequent and less severe than turbulence between the altitudes of 20,000 and 40,000 ft.
- **Aircraft flying** between 60,000 and 75,000 ft. are in turbulent air less than 2% of the time. For given values of gust velocity, the frequency of gusts at these altitudes is less than one-tenth that at the lower velocities.
- **One notable exception** has been found to these findings. Over Japan the air from 40,000 to 60,000 ft. appears more turbulent than at lower altitudes.

At the right a McDonald *Green Quail* Missile is being launched from a B-47. The *Green Quail* ground support trailer is shown below.



Trailer mounted RMC-Lindsay pressure gauges give fast, dependable systems check for unerring flight of Green Quail

Fast, because they are designed for maximum readability and quick response. Dependable, because of their simple direct-drive operation and precise construction.

The RMC-Lindsay gauge is completely different from the usual pressure gauge. Instead of the common "C" type bourdon tube, the RMC pressure element is a helical bourdon coil which offers greater resiliency and longer accurate cycling life. Instead of the pointer being actuated through the usual linkages, gears, hair springs and the like, the RMC pointer is attached directly to the end of the helical bourdon pressure element. This eliminates waver and lag, wear and slippage; provides exceptional resistance to the destructive effects of vibration, shock and pulsating pressures.

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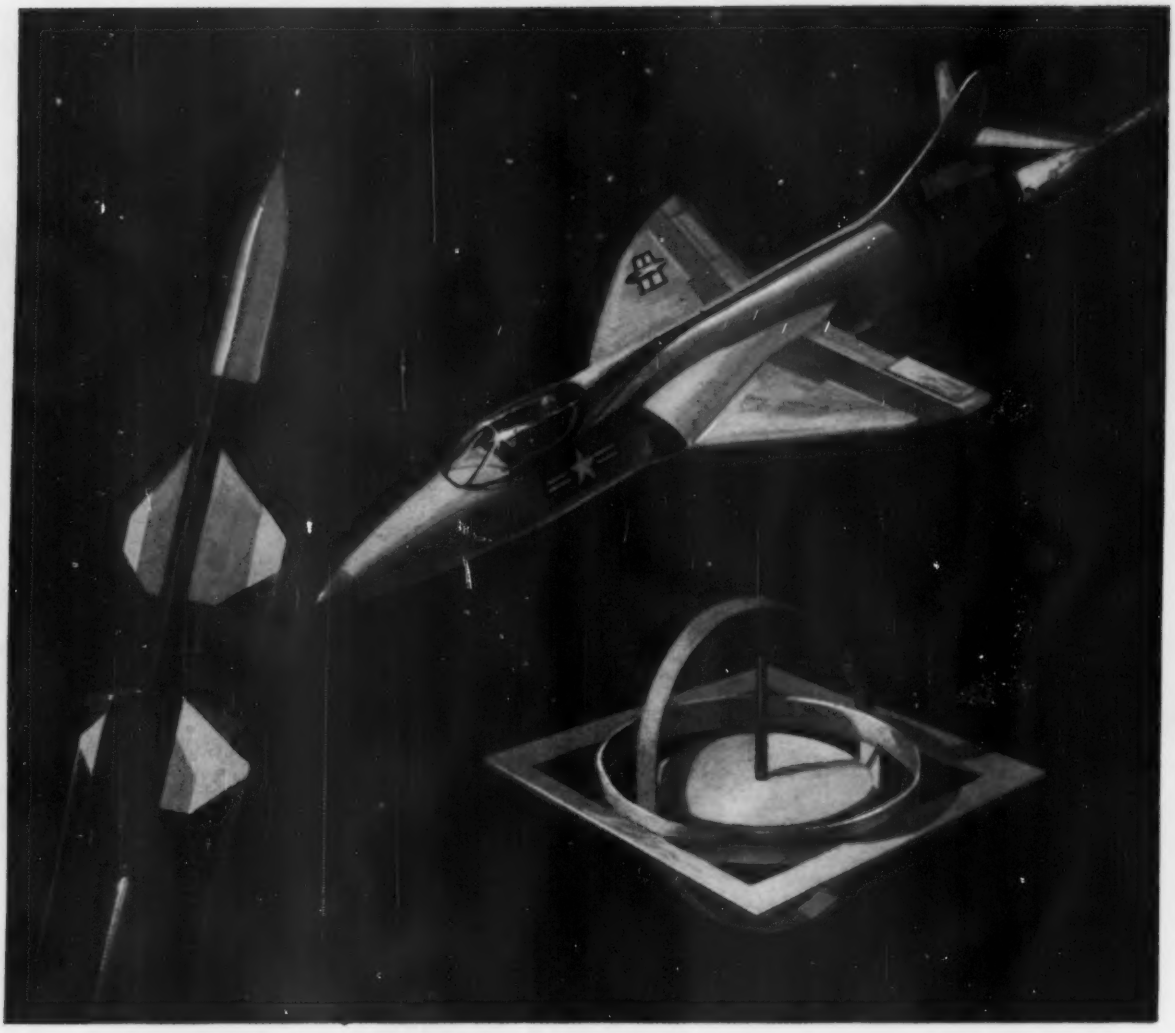

20-pound inertial platform

By a precise balancing exercise, this silent, sleepless "pilot" will keep its craft on course as it streaks through space. The miniature, all-attitude inertial platform detects any pitch, roll or yaw deviations and is the heart of a precise navigation system.

The best news of all concerning this new inertial platform is Norden's success in achieving higher accuracy and reliability . . . in a significantly smaller package. The unit measures a mere 7⅛ x 9⅜ inches and weighs less than 20 pounds. It offers optimum state of the art wherever stabilized spatial reference is required. This engineering accomplishment once again underscores Norden's capability in the fields of digital computing, gyro design and application, reliability techniques, and precision manufacturing. And it is a demonstration of the Norden philosophy at work . . . to extend man's capabilities.

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WIND TUNNEL MODEL (left) is currently being modified to the configuration of the display model at right. Chance Vought's V/STOL logistic transport, capable of carrying 20 soldiers, would have articulated wing flaps to divert airflow downward for vertical or short takeoff and landing. Wind tunnel model has powered fans and flaps.

Chance Vought Studies V/STOL Design

By Erwin J. Bulban

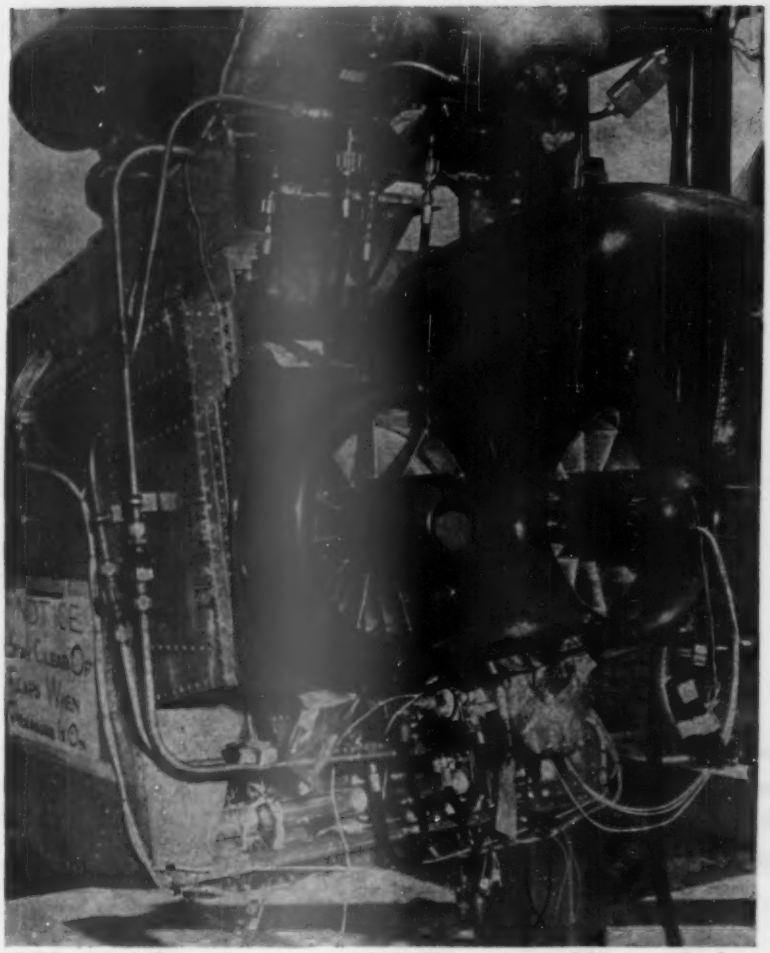
Dallas, Tex.—Chance Vought Aircraft, Inc., could fly the prototype of a vertical or short takeoff and landing logistic transport capable of flying 400 kt. and having a ferry range of more than 3,000 mi. in two years from design go-ahead using currently available hardware and state-of-the-art knowledge, the company reports.

Chance Vought engineers have been studying V/STOL transport problems here for the past two years, using company funds, and have developed a propulsion and control system utilizing four Pratt & Whitney J60 turbines driving ducted fans.

Design Concept

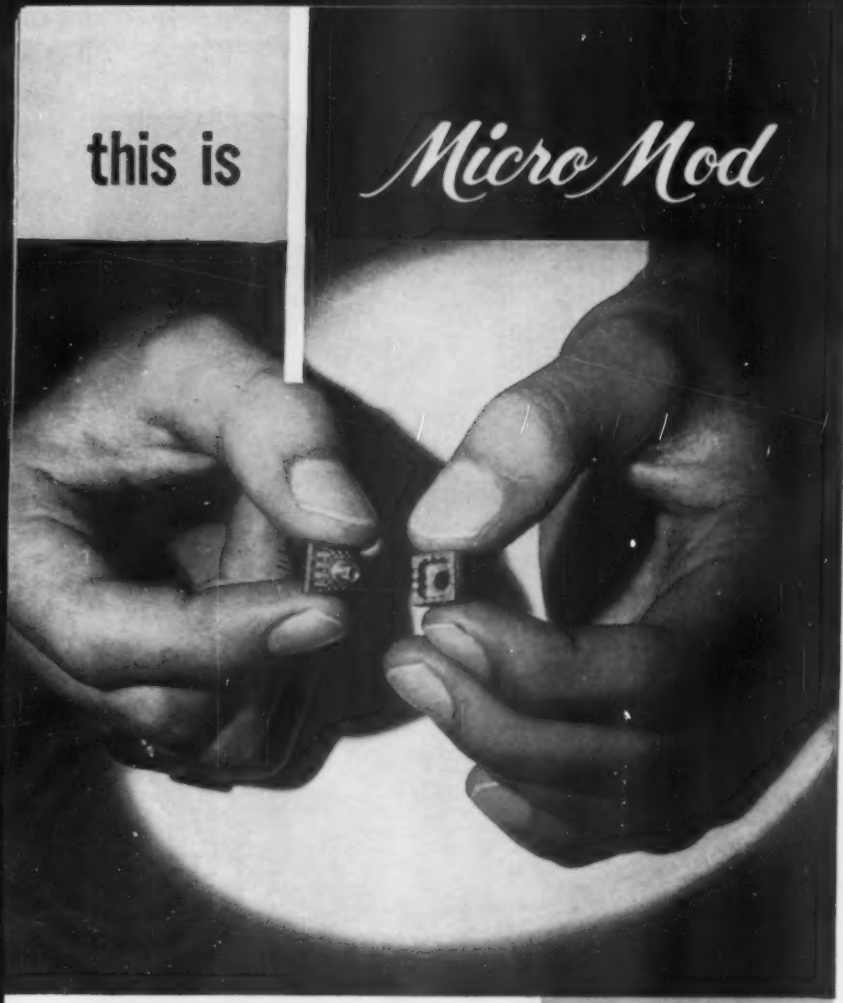
Their concept is termed ADAM, for air deflection and modulation. As designed and tested here—both in outdoor testbed rigs and in the company's low-speed wind tunnel—the fan duct, wing, power generation and transmission and control system are integrated in a single package to generate both lift and forward propulsion. The four fans are arranged side by side in pairs on either side of the fuselage; their axes are parallel to the line of flight.

The propulsion system is a non-concentric turbofan design, two J60s mounted above paired fans. The fan drive turbine for each engine is not integral with the engine but is remotely sited. Compressed gas from each engine flows aft through an interconnected hot gas duct and drives a turbine at its aft end. A crossflow connection between the pairs of ducts on both sides of the airplane can be used to equalize engine thrust to the four tur-



TESTBED RIG of Chance Vought's ADAM V/STOL propulsion and lift system has been built outdoors for large-scale tests of the system, including duct entry shapes. This scale model represents one complete power system. The large pod represents two Pratt & Whitney J60 turbojets which would drive the two turbofans.

this is *Micro Mod*

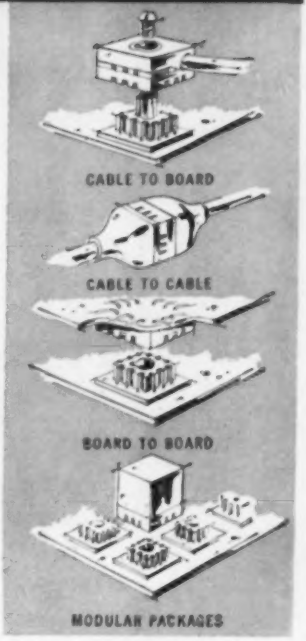


A pair weighs 0.73 grams; they are .380 square; there are 12 gold-plated beryllium copper contacts on .075 centers: this is Micro Mod, AMPHENOL's new connector family for modular circuitries!

Available in two constructions, Micro Mod can be used with module ("or stick") circuits or in cable plug applications—wherever micro-miniaturization must be combined with outstanding reliability.

96-4 plug is used with 96-3 receptacle; the latter is supplied less contacts—the module leads are used to form the female contacts. 96-2 plug is supplied with a polarizing key assembly, mates with 96-1 receptacle.

Micro Mod, Micro Min (19 and 38 contacts) and Micro Edge (15 contact P.C. receptacle) are available now for your evaluation. Write for information and cataloging.



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bines in event of failure of any of the engines.

Rotation of each turbine causes rotation of the fan coupled to the turbine by a common shaft. Ambient air is drawn into the fan duct and vented through a nozzle at high velocity to furnish thrust for both vertical and horizontal flight.

A variable exit nozzle in each fan duct is used for transition between vertical and horizontal flight. Airflow from both fans of each pair merges into a single stream in the duct and exits through a rectangular nozzle at the trailing edge of the duct.

Control System

Upper and lower surfaces of the nozzle consist of articulated flaps actuated by hydro-mechanical controls. For vertical flight, the flaps are positioned to direct nozzle airflow downward at 80 deg. below the airplane's axis, and since the normal airplane attitude is 10-deg. nose up, airflow is perpendicular to the ground.

Transition to horizontal flight is accomplished by repositioning the nozzle flaps to direct the airstream aft. According to Chance Vought, this system minimizes wing stall or airflow misalignment during transition that could occur during rotation of wings or engine pods.

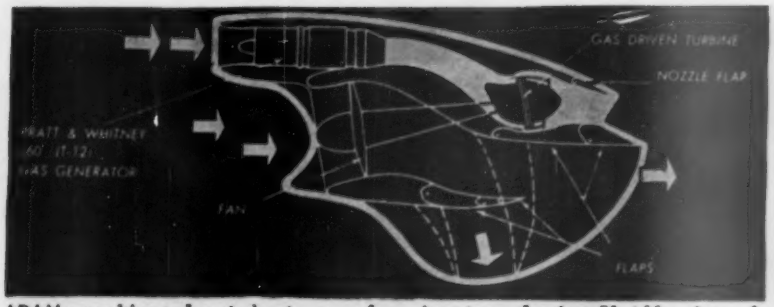
Control system also utilizes the primary lifting jet to provide hover stability about all three axes. This is achieved by deflecting the nozzle flaps to direct the two streams of air as required for roll, pitch or yaw control.

Varied Missions

Chance Vought engineers have made several preliminary design studies utilizing the ADAM system, including the logistic transport, an assault transport, rescue-recovery, anti-submarine, surveillance and transport aircraft. The logistic transport, for example, would provide a general purpose cargo and troop carrier with 600-cu. ft. of internal cargo volume or seats for 20 troops. Horizontal tail is mounted atop the vertical tail, with a single aft loading ramp which is opened in flight for air drops.

The assault aircraft has tricycle landing gear with two positions available on the nose gear for loading and takeoff. The ADAM power packages are positioned on the sides of the fuselage and the aft end of the fuselage is provided with clam-shell doors. Tail is supported on twin booms.

Test programs on the concept have been carried out on scale-model ADAM propulsion ducts to check intake and exit losses and flow distributions. A test program to investigate the control moments available from the lifting jet, using a 1/25th scale model ADAM propulsion and control pod, is cur-



ADAM propulsion and control systems are shown in cutaway drawing. Variable exit nozzle in each fan duct is used for transition between vertical and horizontal flight.

rently being completed. Wind tunnel tests of an airplane model equipped with powered fans and flaps are currently being made to further investigate aerodynamic characteristics.

Control characteristics and requirements and pilot display programs will be handled by a flight simulator using data obtained from the propulsion and control pod and powered model studies. Chance Vought expects to complete tests on its ADAM concept early next year

Belgium, W. Germany Sign Logistics Pact

Bonn—Final papers for establishment of a "rear-area" West German logistics support depot in the Belgian province of Antwerp have been signed by representatives of the two governments involved.

Under terms of the agreement, worked out under the auspices of the North Atlantic Treaty Organization, a tract of land near the town of Arendonk will be leased to the West Germans at no cost for a period of 30 years. Either government, however, may terminate the pact upon one year's notice. West German government, which will bear construction costs, hopes to have the depot in operation by mid-1962.

The agreement, which represents another step in West German efforts to obtain defensive rear-area air bases, staging points and depots, is similar to an earlier arrangement whereby Rhine river barges stocked with German army ammunition and medical supplies are docked in The Netherlands.

Link Builds B-58 Simulator

Vertical movements of the Convair B-58 Hustler due to pitch changes at high angle of attack attitudes have been incorporated in a cockpit simulator by Link Division of General Precision, Inc., for Convair. Link reproduced the B-58's vertical movement characteristics by placing the cockpit simulator on a hydraulic forklift. Thus, the cockpit can be accelerated up and down through a 25 in. plane and, simultaneously, its pitch angle can be varied. The vertical movement and the pitch also can be operated independently.

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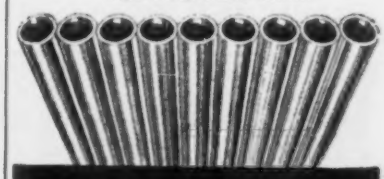

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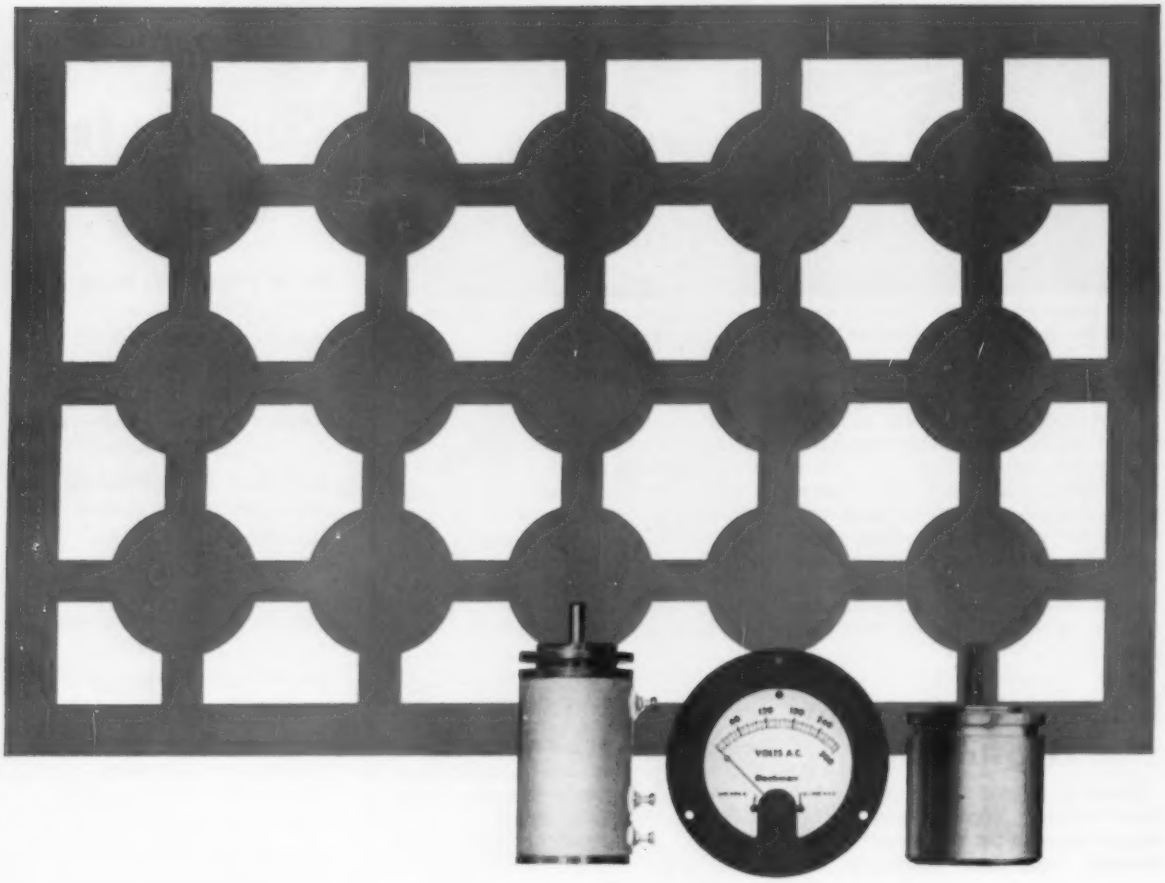

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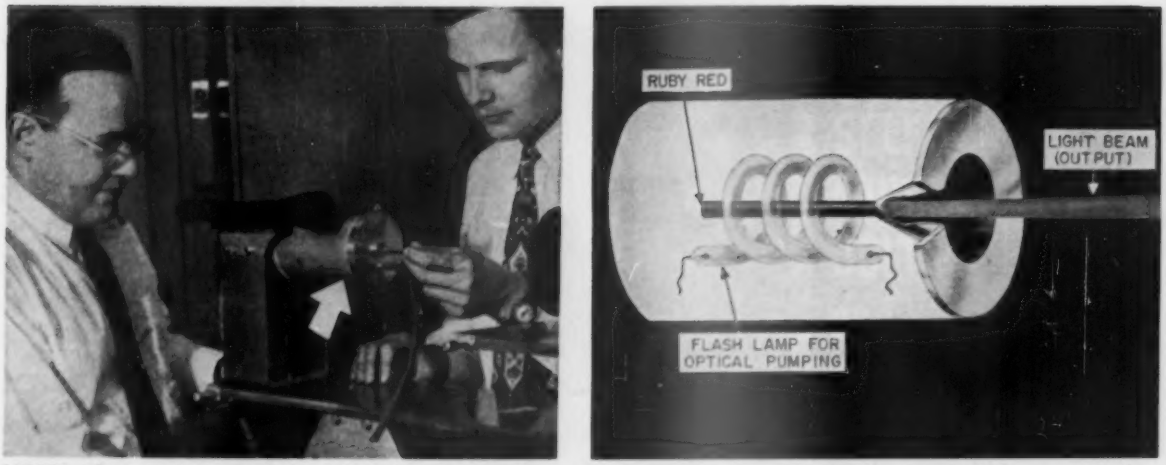


PULSED ruby optical maser, which produces high-intensity beam of coherent light, has application for space vehicle communications and may also open up a vast new spectrum for earth communications. Device at left was developed by Bell Telephone Laboratories. Drawing at right shows that optical maser is extremely simple, consisting of a thin rod of synthetic ruby, silvered at either end, which is excited by pulses of light produced by helical flash tube. Output beam is 0.1 deg. wide, more intense than sun.

Optical Maser's Space Potential Probed

By Philip J. Klass

New York—Bell Telephone Laboratories experiments have revealed that an optical maser exhibits relaxation oscillator effects, with coherent light being emitted in short (microsecond) bursts rather than as a smooth pulse as had been previously reported by Hughes Aircraft scientists (AW July 18, p. 96).

This suggests that it may be possible to modulate the emitted light for space communications and conventional earth-based communications. BTL scientists speculate that millions of new communication channels may be opened by the use of modulated optical maser light beams transmitted through dust-free waveguide.

Using the newly developed optical maser as a source of high-intensity, narrow-beam light, BTL scientists have transmitted pulses of light between Murray Hill and Holmdel, N. J., a distance of nearly 25 mi. Optical maser light pulses also have been transmitted along a quarter mile of two-inch diameter circular waveguide, sealed to prevent light beam attenuation from dust and fog (AW Oct. 10, p. 34).

Synthetic Ruby

The BTL optical maser uses a synthetic ruby crystal, employed in a manner originated by T. H. Maiman of Hughes, who first observed the optical maser effects in ruby. The BTL crystal is about 1¼ in. long and 0.2 in. in diameter.

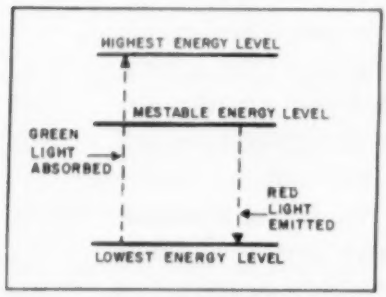
When excited by a flashtube, fired by a bank of condensers, the ruby rod emits intense pulses of light, at a wavelength of 6,943 angstroms and of a bandwidth of less than one angstrom. This essentially monochromatic light, emitted within a cone angle of about 0.1 deg., is more than a million times brighter than the sun, BTL says.

The results of BTL's optical maser experiments check with those of Hughes, except that Bell scientists found that pulses of light emitted contained several hundred intense short bursts, each of about one microsecond duration, superimposed upon the average emitted light intensity. If these were observed by Hughes scientists, they were not reported at the time of their announcement several months ago.

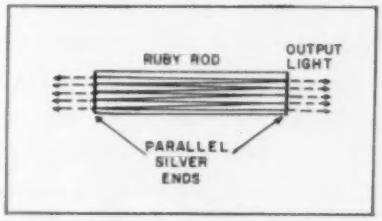
The ruby employed in the optical maser is crystalline aluminum oxide, in which a small fraction of the aluminum atoms are replaced by chromium atoms. Normally the chromium atoms, which produce the optical maser effect, are at their lowest energy level, one which is stable unless the atom is excited.

If, however, the ruby's chromium atoms are exposed to green light of the proper wavelength, or white light which contains green along with other colors, the chromium atoms are excited, absorbing energy from the green light, and they will be raised to a high energy level.

This high energy level is an unstable one, and the atoms quickly fall back to an intermediate energy level, emitting energy in the form of red light in the



WHEN OPTICAL MASER'S ruby rod is illuminated by green or white light (containing green), chromium atoms in the ruby absorb energy, rise to highest energy level. Atoms then rapidly drop to intermediate (mestable) level after which they slowly return to slowest level giving off red light, called spontaneous emission.



SILVER COATING at each end of ruby rod causes spontaneous emission light to be reflected back and forth, which causes atoms at mestable level to cascade down to lowest level, producing intense red light which passes through thin coatings at each end of the rod, giving coherent beam.

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It makes certain that only aircraft with properly operating weapon control systems are sent on missions. Based on a building-block design employing the highest reliability factors, a mechanical programming device and self-test capability, DATS utilizes a series of synthesized attack runs typical of mission conditions. DATS could be made applicable to many interceptor types of aircraft.

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COHERENT light beam emitted by Bell Telephone Laboratories pulsed ruby optical maser.

process. This level is termed the "mestable level," being more stable than the high level, but less stable than the original low level.

Slowly some of the chromium atoms in the mestable energy level relax, giving up energy in the form of red light, and return to their original low energy level. This is referred to as "spontaneous emission," corresponding to the ordinary fluorescence of ruby. This is similar in principle to the light given off by a conventional fluorescent lamp when excited by ultraviolet radiation generated within the lamp.

If, however, the chromium atoms at the mestable energy level are exposed to red light of precisely the same wavelength as they emit when dropping down to the lowest energy level, they will be stimulated to make the "last jump" more quickly.

Stimulated Emission

To produce this stimulated emission, both ends of the ruby rod are precisely ground parallel and silver coated to provide reflecting surfaces. As the few chromium atoms at the mestable energy level begin to drop back to the lowest level due to natural causes, the red light they emit in the process ("spontaneous emission") is effectively trapped within the ruby rod, being reflected back and forth by the two mirrored ends.

This spontaneous emission light is precisely the correct wavelength to activate the bulk of the chromium atoms in the mestable level, causing them to fall back to the lowest energy level and emit intense red light in the process.

Duration of Process

The process continues as long as there is a supply of chromium atoms at the mestable energy level. This will exist so long as the green or white light is pumping atoms from the lowest level up to the highest level, from which they can drop back to the mestable level.

The silvered surfaces at each end of the ruby rod are coated sufficiently thin to permit a portion of the intense red light to pass through. It is this externally emitted beam of light that was used in BTL's long-distance experiments.

One of the most interesting properties of the optical maser is its ability to generate coherent light, the first known source of such light. Light produced by the sun, incandescent or fluorescent lamps is incoherent, with the packets of light emitted in completely random fashion.

The light emitted by the optical maser consists of packets of light which are coherent waves, much like radio or sound waves. This coherence has been

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Missile monitor closed-circuit television camera, Type TE-9-A, is mounted in rugged housing to permit close exposure to rocket engine blast. The transistorized camera provides 650-line resolution, can be equipped with four-lens turret. Device measures 11¾ in. long, 5¾ in. in diameter. Manufacturer: General Electric Communication Products Department, Lynchburg, Va.

demonstrated by arranging two fine, parallel slits in a thick silver coating on one end of the ruby rod. The pattern of emerging light showed that light from one slit was interfering with that from the other, an indication that the emitted light was in phase across the end of the rod, BTL reports.

The underlying reason why the optical maser generates coherent light is not fully understood. It may result from the cooperative reaction between the spontaneous emission light, reflected back and forth, and the stimulated atom emission, perhaps resembling the reaction of a field and electron beam in a klystron.

The light emitted by the ruby under stimulated emission (maser action) is much more nearly monochromatic, by a factor of 60:1, than light produced by spontaneous emission as atoms fall back to the lowest level because of natural causes.

Pulsed Output

BTL scientists have developed a theory which may explain the pulsating output of the ruby maser's emitted light. Each of these pulsations, or bursts, is less than a microsecond long and occurs a few microseconds apart.

This theory holds that when the pumping flashtube is illuminated initially, it builds up a supply of atoms at the mestable energy level. As spontaneous emission occurs, the intensity of light in the ruby builds up to a point where it stimulates the remainder of the chromium atoms at the mestable level to cascade down to the lowest level, producing an intense pulse of light. This depopulates the mestable region so rapidly that it then requires a short interval for the flashtube to pump enough chromium atoms to replace the depleted population, causing a drop in the emitted light intensity. When the supply of chromium atoms in the mestable energy level is built up, the cycle repeats itself.

Bell scientists report that these pulses, or spikes, become more pronounced as the thickness of the silver coating at each end of the ruby rod is increased and the more nearly perfect the rod's geometry. The interval between spikes has been found to decrease as the exciting flashbulb intensity is increased. Similar phenomena have been observed in ruby masers at microwave frequencies.

In subsequent experiments, in which ruby crystal was immersed in liquid nitrogen for cooling, Bell scientists found that the threshold for the occurrence of stimulated emission was 30% lower than at room temperature.

Further Research

BTL says its optical maser effort is expanding into techniques for modulation, amplification and detection, as well as research on the luminescent properties of materials other than ruby suitable for operation at other optical frequencies.

Bell Telephone Laboratory scientists engaged in the pulsed ruby maser experiments include: R. J. Collins, D. F. Nelson, A. L. Schawlow, W. L. Bond, C. G. B. Garrett and W. K. Kaiser.

Electrically Heated Rubber Controls Ice

B.F.Goodrich fabricates rubber units with integral electrical heating elements for bonding to complex curves and odd shapes as well as flat surfaces. These units control ice formation in localized areas such as air intakes, cowls, propeller blades and spinners. Elements are thin; can be applied underneath skin or externally.

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Proven by more than 30,000 flight hours in airline and corporate aircraft without malfunction, the Pyrotector Smoke Detection system represents a giant step forward in the safety of air travel. Through light reflection principles, Pyrotector units actually, "see" smoke in unguarded areas, and give an alarm before combustion can reach dangerous proportions. As many as six detectors may be connected to one control unit, providing protection for several different baggage and equipment areas with one system. This proven system assures 100% aircraft smoke detection.

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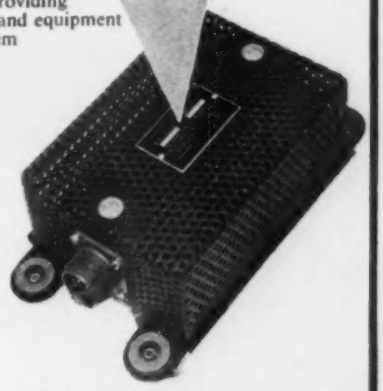

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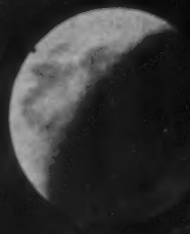


CAPABILITIES

Cooper Development Division to Centralize Operations in Van Nuys

In the next few months the entire Cooper Development Division will move to the Van Nuys headquarters of The Marquardt Corporation. By concentrating aero/space operations in one centralized, fully equipped facility, the full capabilities of Cooper can be better focused on the technological problems facing government, industry, and private research groups.

Cooper Development Division will be in direct contact with extensive testing facilities and the combined experience and knowledge of the Power Systems Group and the ASTRO Division. Power Systems Group maintains an outstanding reputation in advanced rocket engine concepts, fuels and propellant research, high temperature materials development and experimentation, and advanced manufacturing techniques. A close working relation with the ASTRO Division will provide a nationally recognized source of basic and applied research information as it pertains to CDD's operations.

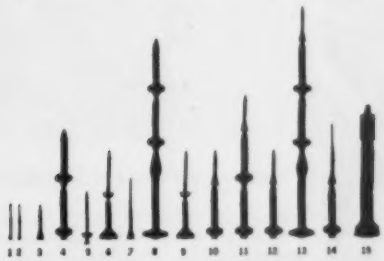
CDD, located in Monrovia, California when acquired by Marquardt in 1958, provides complete and proven high altitude rocket research services. These high altitude or space probe systems are designed for wind measurement; meteorological, radiation and biological information; and similar military and scientific high altitude aero/space programs.

CDD supplies a complete project service—from design, development, and production to field testing and data evaluation—for rocket research systems. Now with immediate access to larger testing and manufacturing facilities and directly supported by Marquardt's more than fifteen years of comprehensive experience in the propulsion field, CDD can offer their customers broader, faster problem solutions on an even more competitive cost basis.

Detailed information covering Cooper's experience, capabilities, products and services may be obtained by writing A. B. Metsger, Vice President-General Manager, Cooper Development Division, The Marquardt Corporation, 16555 Saticoy Street, Van Nuys, California.

Engineers and scientists experienced in aero/space activities are invited to acquaint themselves with the outstanding career opportunities in the field of rocketry at The Marquardt Corporation.

The Cooper Family of Rockets



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9. TERRIER—ASP 300
10. ASPAN 150
11. COBRA
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2" diameter Formlite valve, with solenoid. This size weighs 1.42 lbs. Can be used for many air-flow control purposes.

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HOT AIR IN-LINE VALVES

- Small, compact . . . lowest weight-to-size ratio
- Positive, reliable operation—only one moving part
- Less than .001% leakage
- Widest operating temperature ranges . . . from —65 F. to 850 F.
- Corrosion-resistant materials
- Meets Military Specifications
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- Fast-acting . . . less than 1 second response time, when desired
- Extremely low pressure-drop

Văp-Air Formlite in-line valves are solenoid-controlled and pressure-actuated. They provide the operational advantages of older, poppet-type valves (fast action and tight closure), with far lower weight-to-size ratio. Weight ranges from 12.5 oz. for 1¼" valve to 2.5 lbs. for 3" valve.

Valves are fabricated of aluminum, corrosion-resistant stainless steel, monel or similar metals. They operate at duct temperatures from —65°F. to 850°F., on duct pressures as low as 2 psi, and as high as 300 psi, or more. Specially designed disc and valve seat insures positive opening and closing, with less than .001% leakage at full pressure.

Formlite valves are used to control jet engine bleed air, anti-icing air flow to engine shrouds, leading edges of wing and tail, windshield defrosting or rain-removal air flow, compartment air-flow, or as safety shut-off valve up-stream from other pneumatic systems.

They have only one moving part, and operate in ambients up to 850°F.

Văp-Air Formlite valves conform to military specifications, have passed required sand, dust, shock, vibration, salt-spray, humidity, and sustained-use tests.

They are made in various duct sizes from ¾" to 4" with various types of end fittings. They can be supplied with any type of connection; made to open or close in less than one second; designed to fail-safe in either open or closed position should power be interrupted. Electrical power requirement (AC or DC) is extremely low. No limit switches are needed.

for complete technical information and applications write:

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Please send information on Vap-Air Formlite In-Line Valves.

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USAF Inaugurates Logistics Network

New York—First of five new automatic switching centers for U.S. portion of Air Force's Combat Logistics Network (ComLogNet), which will enable network to handle equivalent of 100 million words daily, is scheduled for operation next year, with the complete system operational by early 1962.

The ComLogNet will link approximately 450 air bases, stations, depots and civilian suppliers. New high-speed data handling and switching centers were designed by Western Union, which will lease them to the Air Force.

System will be able to transmit variety of signals, including digitized voice, data and graphic information, with automatic message encrypting. System will enable any station to obtain direct connection with any other for volume transmission. Transmission speed will be 50 words per second.

The five automatic switching centers will be located at Norton AFB, Calif., McClellan AFB, Calif., Tinker AFB, Okla., Gentile AFB, Ohio, and Andrews AFB, Md.

FILTER CENTER

▶ **Microwave Tube Breakthrough Reported**—General Electric says it has achieved a "revolutionary breakthrough" in high power microwave tubes. One

Electrostatic Gyro Operates 100 Hr.

Electrostatic gyro which employs rotating sphere suspended by an electrostatic field in an evacuated housing has operated successfully for 100 continuous hours, according to General Electric Co.'s Light Military Electronics Department which is developing the device (AW Feb. 1, p. 72) for the Air Force. Absence of mechanical contact between rotating sphere and housing should reduce wear, make for long life and high reliability. Automatic readout equipment provides digital indication from which gyro rotor spin axis relative to craft mounted support can be determined. Use in satellites or space vehicles where low gravity-force environments should enhance anticipated low drift rates is principal application.

LISLE *Magnetic* CHIP DETECTORS

Metal particles in an engine or accessory lubricant are a proven indicator of internal breakdown. Early detection of this condition is being accomplished today, in both commercial and military aircraft, with Lisle Magnetic Chip Detectors.

A powerful magnet in the Chip Detector attracts any ferrous particles that may appear in the lubricant. These particles bridge an electrically insulated gap, completing a circuit which activates a light on the Flight Engineer's or Pilot's instrument panel. Early detection means constant protection against in-flight failure.

As an alternative to a permanently wired system, Lisle Chip Detectors can be ground checked with a continuity tester.

Write for Catalog and Samples for Testing

LISLE CORPORATION
Clarinda, Iowa

Tom Swift and his moon rocket

All was ready. Tom called to Professor Damon, "Let's start our high energy, liquid hydrogen rocket engines!"

The professor wiped his glasses and agreed. "Bless my overshoes, let's!"

Fiction? Only the names have been changed. The rocket is really a development of the National Aeronautics and Space Administration, and its name is Saturn. Its first stage will develop a thrust of 1.5 million pounds—twice that of anything the Soviets have fired so far. It is designed to take two men around the moon and back.

You can read the full story in McGraw-Hill's AVIATION WEEK and Space Technology, as covered by Space Technology Editor, Evert Clark.

Clark has kept AVIATION WEEK subscribers abreast of space developments (U.S. *and* Soviet) long before Sputnik I put the international spotlight on space technology. He personally covered launchings of the Atlas, Titan, Thor, Jupiter, Redstone and Polaris missiles—and also Explorer satellites, Pioneer lunar probes, Pioneer V Venus probe and Juno satellites.

From this extensive background, Clark directed preparation of AVIATION WEEK's first special issue on space research in 1958. He has also been responsible for other special issues on the NASA and the Air Force Air Research & Development Command and has written extensively on Soviet space developments.

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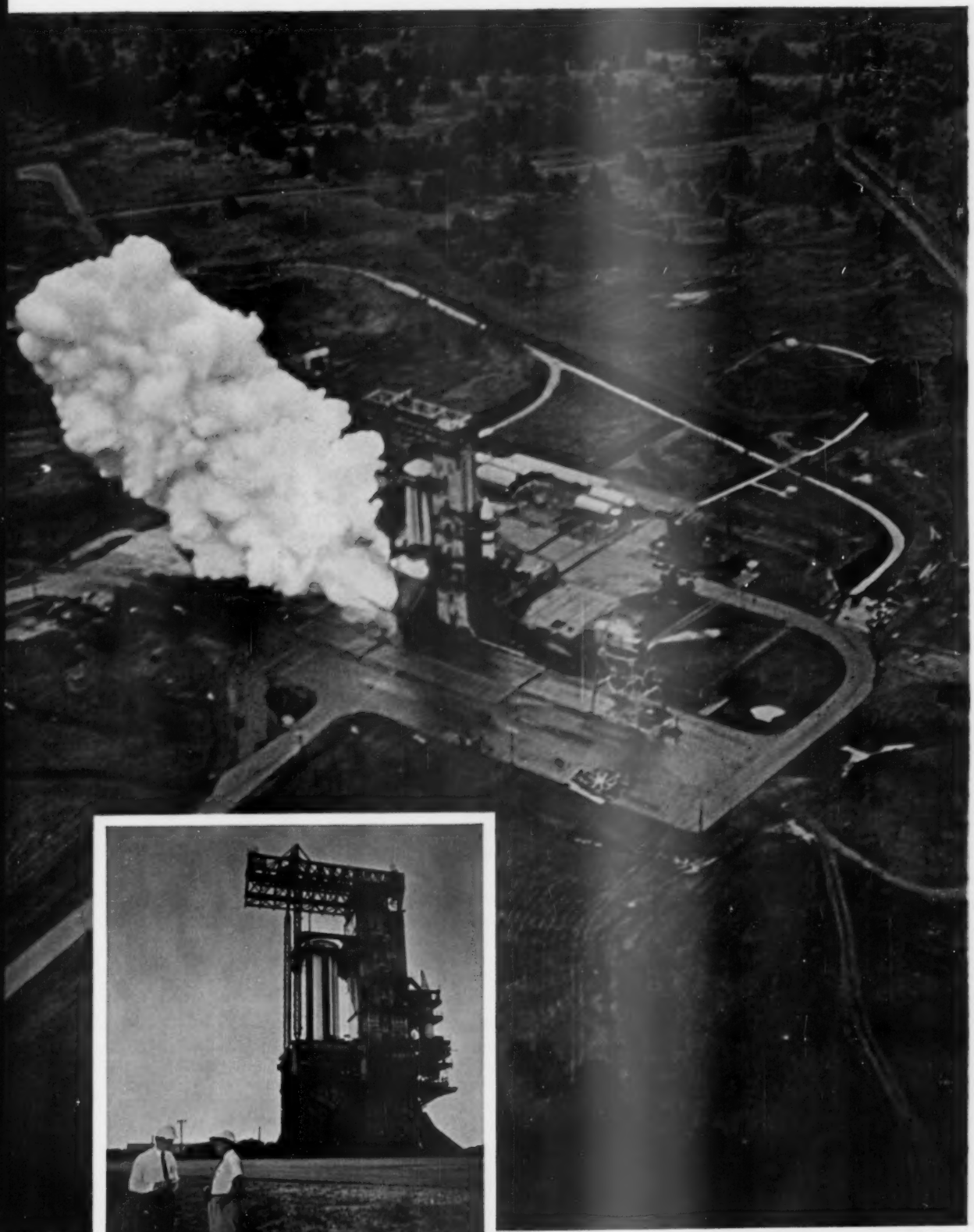
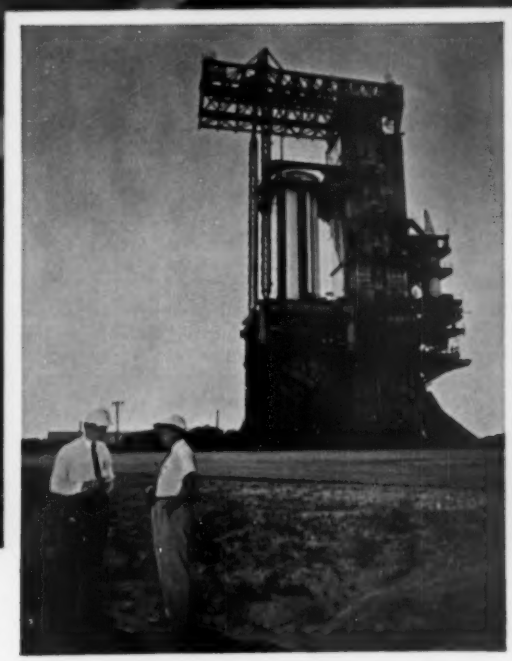
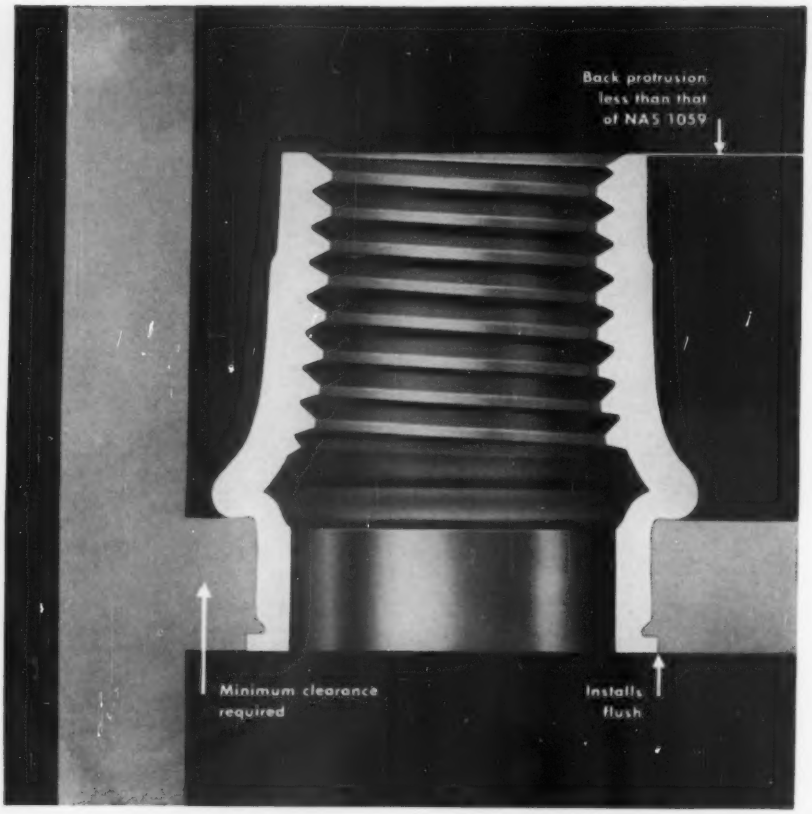
Evert Clark (left) checks technical details for a story of the Saturn with B. R. Tessman, deputy director of the Test Division, Marshall Space Flight Center. A space technology scientist since 1935 in Germany and the U.S.A., Tessman typifies the authorities that McGraw-Hill editors like Clark work with in covering a story. Clark himself has covered international space meetings in London and Stockholm . . . maintains contact with men like Tessman on space research around the world.







SPS DAVIS PRESS NUT
. . . new method of blind fastening

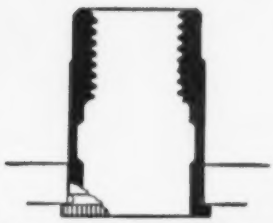
This new one-piece, one-operation Davis nut is simplicity itself. A true blind fastener, it is installed from one side . . . with one tool . . . in one operation. And unlike riveted plate nuts, it requires only one hole. Thus you eliminate extra drilling and peening operations, simplify inventory, save assembly time and costs.

Lightweight, self-locking SPS Davis Press Nuts provide a flush surface when installed. Further, their configuration permits installation close to corners or flanges . . . closer than plate nuts. Back protrusion is also considerably less than that of NAS 1059 (Fasteners—Blind—High Strength) in all sizes and grip lengths, providing additional opportunities for miniaturization.

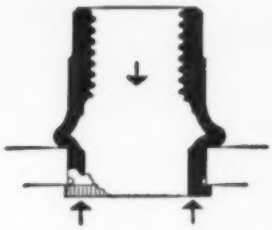
Reliability? Locking torques of installed SPS Davis Press Nuts meet or exceed requirements of MIL-N-25027 for 15 applications. Push-out and torque-out values are definitely higher than for plate nuts. Fatigue strength of a joint fastened with Davis nuts is twice that of joints utilizing plate nuts. And they are designed so that bolt threads are never in shear.

Made of austenitic stainless with a tensile strength of 125,000 psi, SPS Davis Press Nuts are designed for tension and shear bolting to aluminum sheet from .040 to .400 inch thick. With countersinking, they can also be used in steel and other alloys to Rc 21. Four diameters available: #10-32, $\frac{1}{4}$-28, $\frac{5}{16}$-24 and $\frac{3}{8}$-24, each in nine grip lengths (.040 inch increments). Write Standard Pressed Steel for new Bulletin 2681. AIRCRAFT/MISSILE Division, SPS, JENKINTOWN 3, PA. • SANTA ANA, CALIF.

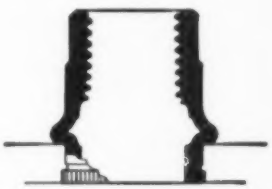
HOW IT WORKS



Only one hole in the sheet is required for Davis Press Nut. Diameter should be sufficient to accept the nut up to the knurling.



Forces (arrows) cause precision-designed section of nut to bellow on side of sheet opposite knurl.



Full pressure imbeds knurled collar in face of sheet, swages bellowed section against reverse side, providing twist-proof grip.

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where reliability replaces probability

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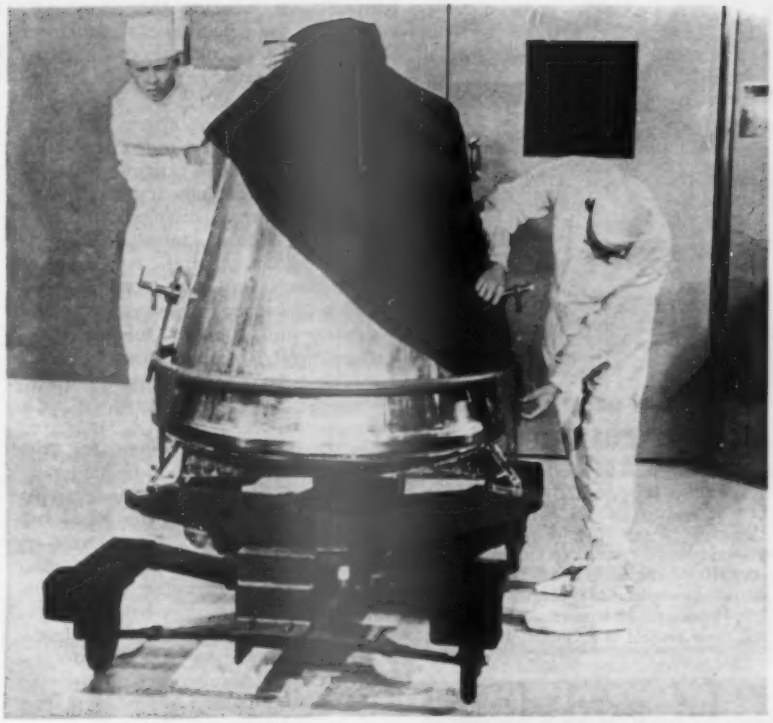
is a new klystron which uses multiple electron beams within a single structure, capable of producing many times more power than conventional klystron, the company says. Other tube, called the Orthotron, uses crossed-field techniques to develop sizable power levels in the micro-microwave band. GE has set up a new Superpower Microwave Tube Laboratory to translate new techniques into operational hardware.

▶ **Nike Zeus Computer Installed**—First prototype of target intercept computer to be used for guidance of Nike Zeus anti-ICBM missile, has been installed at the White Sands Missile Range, N. M. Computer, built by Remington Rand-Univac for Bell Telephone Laboratories and Western Electric, is called the "fastest and most reliable ground guidance computer so far developed." Computer contains 175,000 basic components, employing modular construction for speedy replacement of a faulty unit. Computer uses "twistor" memory elements, developed by Bell Telephone Laboratories.

▶ **Solar Cell Costs May Be Cut**—Technique developed by Army scientists for making radiation-resistant silicon solar cells, using phosphorus doping of P-type silicon, may cut cost of making cells by increasing yield. New process



Samos I Orbiting Vehicle Payload Capsule

Capsule contains payload of initial Samos orbiting vehicle. It was generally described as "test photographic and related equipment," (AW Oct. 17, p. 28).

Electrically - Heated

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can be carried out at considerably lower temperatures, reducing the danger of damage to the silicon crystal structure that exists for conventional boron-doped N-type cells.

▶ **Improved guidance system** for Air Force-Martin Titan was tested in a 5,000 mi. flight down the Atlantic Missile Range recently. The new system permits direct radio control of missile roll-axis by ground station immediately after lift-off, instead of after second stage ignition with first stage control by a preset programmer in the missile. New system permits quicker correction of Titan for initial aiming errors, reducing corrections needed during second stage operation.

▶ **Improved guidance system for Air**—First transistor capable of operating at temperatures above 650F, made from silicon carbide, has been developed by Westinghouse Electric. New device is a unipolar transistor, which operates somewhat like a thyratron tube. The silicon carbide transistors have a power gain of about 60 at room temperature. Successful fabrication of a silicon carbide transistor resulted from development of techniques for producing extremely pure crystals, with less than one part impurity in 10 million parts of silicon carbide, and techniques for forming the semiconductor junction in the extremely hard material.

▶ **Hughes Expands Inertial Effort**—Hughes Aircraft Co. is quietly hiring engineers and physicists with know-how in the gyro and accelerometer field, with the view of entering the inertial components field. The company is a second source on the inertial guidance system for the Polaris missile, but Hughes is buying inertial platform from Minneapolis-Honeywell for use with its own computer.

▶ **Westinghouse to Power VC-10 Jetliner**—Vickers-Armstrongs, Ltd., has ordered a Westinghouse Electric a.c. power generation system, similar to that used on Boeing 707, for company's new VC-10 jetliner. The 400 lb. system supplies 160 kva. of electric power. Westinghouse has received $425,000 contract covering first 10 aircraft.

▶ **Anti-Feedback for Public Address Systems**—Bell Telephone Laboratories has successfully tested an acoustic anti-feedback circuit which permits public address systems to be operated at high level without familiar instability problems. Technique used is to electrically shift the frequency of sound signals by five cycles between microphone and loudspeakers, using a frequency shift

modulator. The shift is almost imperceptible to listeners but is sufficient to prevent ringing and other adverse feedback. Technique allows public address system to operate at levels six to seven decibels higher than would be otherwise possible.

▶**Hound Dog Radar Profile Measured**—North American's Columbus Division is conducting radar reflectivity measurements on a full-scale Hound Dog air-to-surface missile in an effort to reduce its radar detectability. The 43-ft. missile is suspended from a 120-ft. high boom and rotated to various flight positions while its radar reflectivity is measured.

▶**Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

• **Eclipse-Pioneer Division,** Bendix Corp., Teterboro, N. J., has received Air Force contract for XB-70 instrumentation systems, including vertical scale altitude and airspeed instruments and air data computers.

• **Bulova Research and Development Laboratories,** $4.3 million contract from Martin for further work on warhead portion of Army Pershing ballistic missile. New contract brings program total at Bulova to $9.1 million.

• **Laboratory for Electronics,** Boston, Office of Naval Research contract for continuing research in ferromagnetics for application to new storage devices. The program goal is a microminiature memory capable of storing information at densities of one million bits per cubic inch.

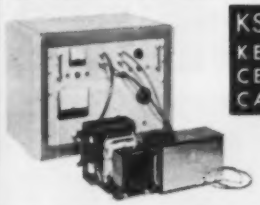
• **John E. Fast & Co.,** Chicago, $421,180 contract from North American Autonetics for development and manufacture of capacitors for use in Minuteman inertial guidance system.

• **Dorsett Electronics Laboratories,** Norman, Okla., $495,000 award from Convair-Pomona for telemetry components for Navy advanced Terrier and Tartar missile programs.

• **Bendix Radio Division,** Baltimore, $750,000 award from Jet Propulsion Laboratory for one-year's maintenance and operation of Goldstone Tracking Station, Calif.

• **General Electric** has a $392,000 Air Research and Development Command contract for applied research on information processing, evaluation and decision-making as part of ARDC's Threat Evaluation and Action Selection program, known as Project TEAS (AW Sept. 19, p. 23.) GE effort is expected to provide basis for development of TEAS concepts and techniques for application to future combat operations control systems.

5 BILLIONTHS OF A SECOND



The KSC-51 Kerr Cell Camera is the fastest high-resolution photographic instrumentation camera in existence. This system is specific for ultra-high speed phenomena. Effective exposure is as brief as 5 nanoseconds. Optical shuttering can be synchronized with the experimental phenomenon to within 1 nanosecond. This instrumentation equipment is of prime interest to the MICRO-TIME oriented engineer or physicist working on . . .

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BOUNDARY LAYER BREAKTHROUGH

50-ton BLC*-130 lands on 500-foot lightplane strips

At the turn-around point of a 2,000-mile round trip mission, Lockheed's new Boundary Layer Control C-130 will roll to a stop in 520 feet after touchdown. Takeoff is just as remarkable: lift-off in 500 feet—from an unprepared field. Stall speed: less than 50 knots.

The BLC-130 is built on a proved and paid-for airframe design. It adds true STOL capability to the other C-130 superiorities established in more than three years of Air Force service: fast loading and unloading; rough-field takeoff and landing; performance of diverse airfreight/airdrop missions at low cost; and direct-to-trouble-spot airlift, such as the recent Congo airlift in which C-130s played the major role.

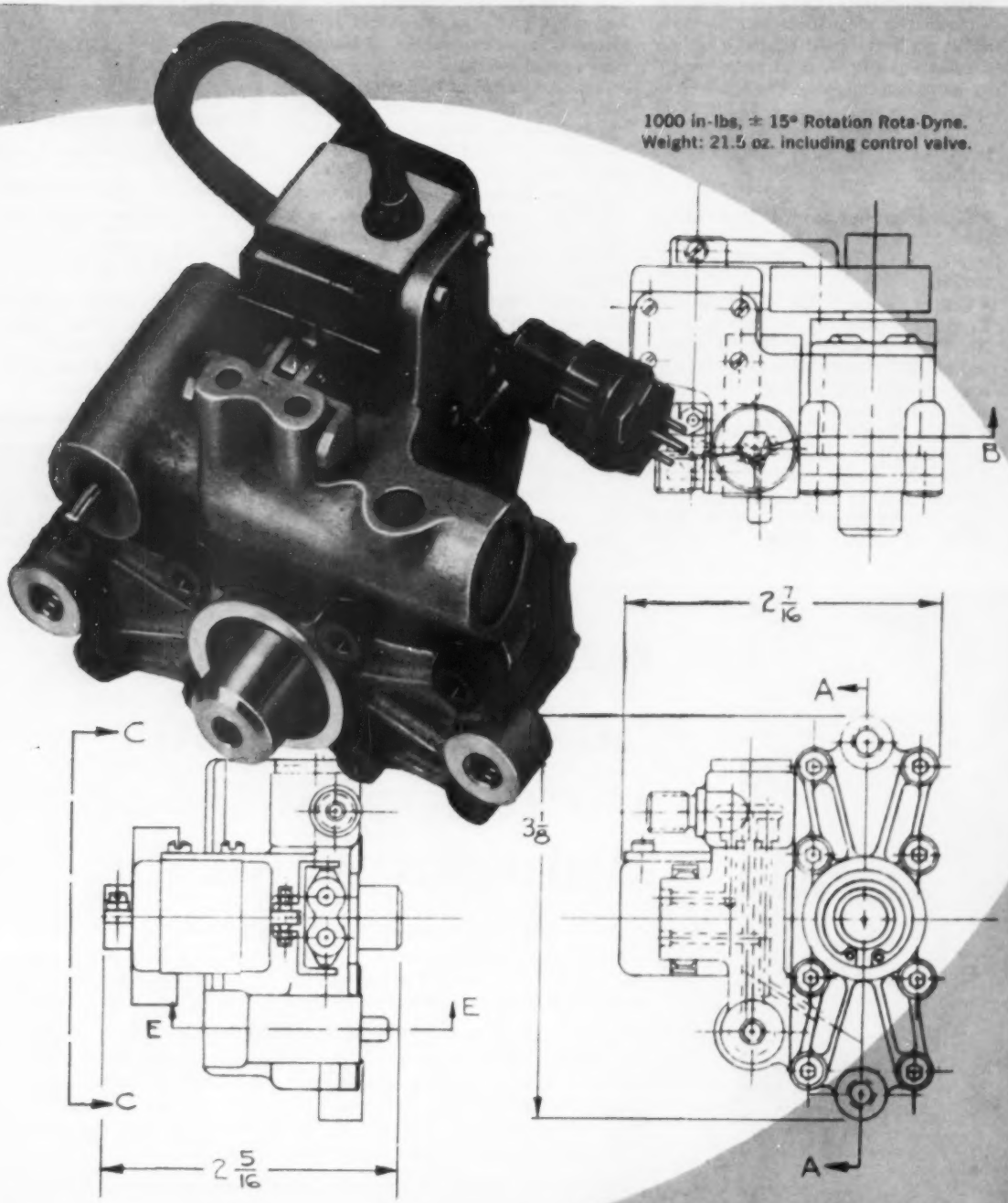
A test bed BLC-130 has completed flight tests, clearly demonstrating the feasibility of boundary layer control on large airplanes.

LOCKHEED

GEORGIA DIVISION • MARIETTA, GEORGIA

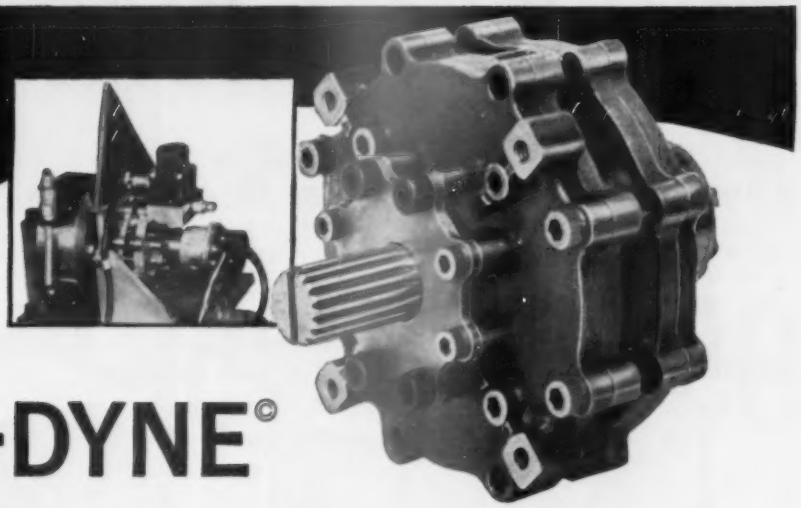
*BOUNDARY LAYER CONTROL—High-speed air from pylon-mounted turbojet compressors is blown over flaps, ailerons, elevator, and rudder—causing airstream to hug the surfaces instead of being separated. The energization of surface air gives the BLC-130 its extraordinarily high lift.

TAPCO POW



Advanced engineering projects at TAPCO offer excellent career opportunities for qualified engineers and scientists. Write Technical Employment Manager.

ER SYSTEMS



2,000 in-lbs, ± 25° Rotation Rota-Dyne. Inset shows unit on test with closed center valve.

ROTA-DYNE©

Rotary Proportional Hot Gas Servos and Pneumatic Actuators

The Rota-Dyne is a true rotary servo which can modulate angular load position over ranges less than a full revolution. It employs a unique sealing technique which is quite simple, but virtually leak-proof and highly reliable. Developed in a company-sponsored program, Rota-Dyne offers these advantages and design features:

- **Direct drive of fins, nozzles or other loads**
- **Low backlash and internal friction**
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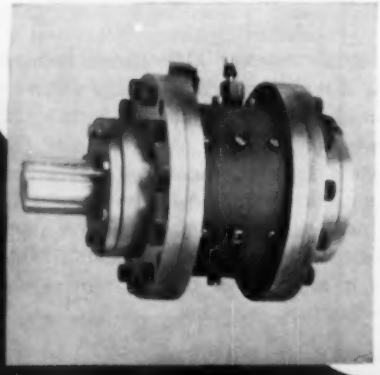

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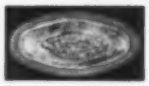

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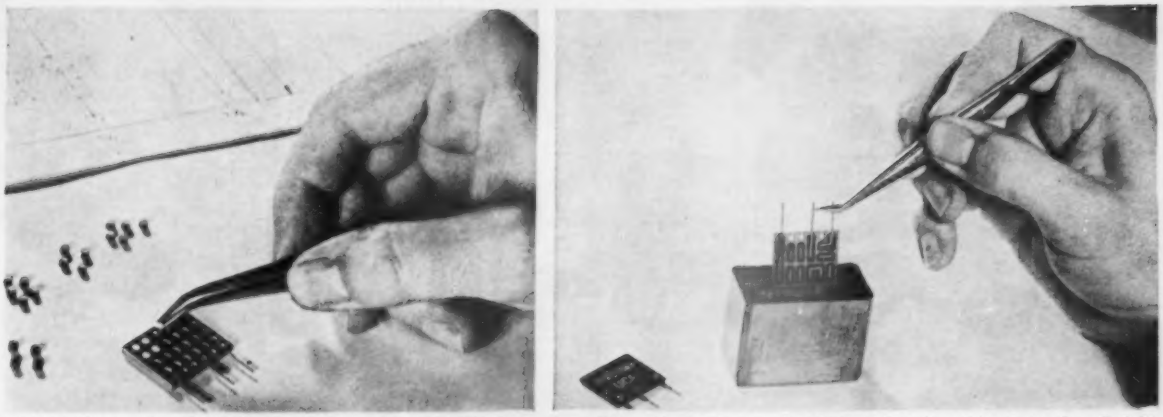
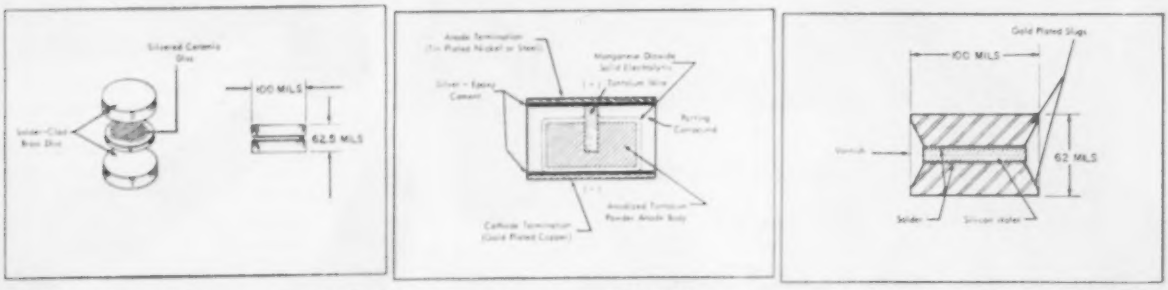


UNIFORMLY packaged, leadless micro components (AW Sept. 5, p. 90) are inserted into plated through holes of insulative board (left) in first step of constructing P. R. Mallory's Unitized Component Assemblies. Partially completed assembly, with masked-on conductors connecting components clearly visible, is dipped into container of protective coating (right). Mallory will provide complete circuits using the cylindrical micro components and assembled in this fashion. Alternately, it will sell leadless components separately for use in buyer's own packaging scheme.



THREE pellet-shaped components made by Mallory are a ceramic capacitor (left), tantalum capacitor (center) and silicon rectifier (right). Uniform component configurations are expected to simplify manufacture and testing, ease shipping and storage and permit high component density packaging in complex avionic equipment.

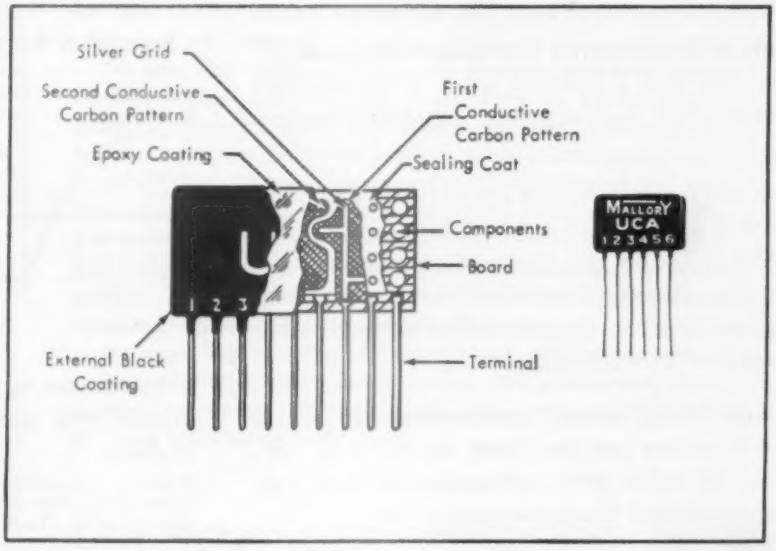
Uniform Component Packaging Offered

By Barry Miller

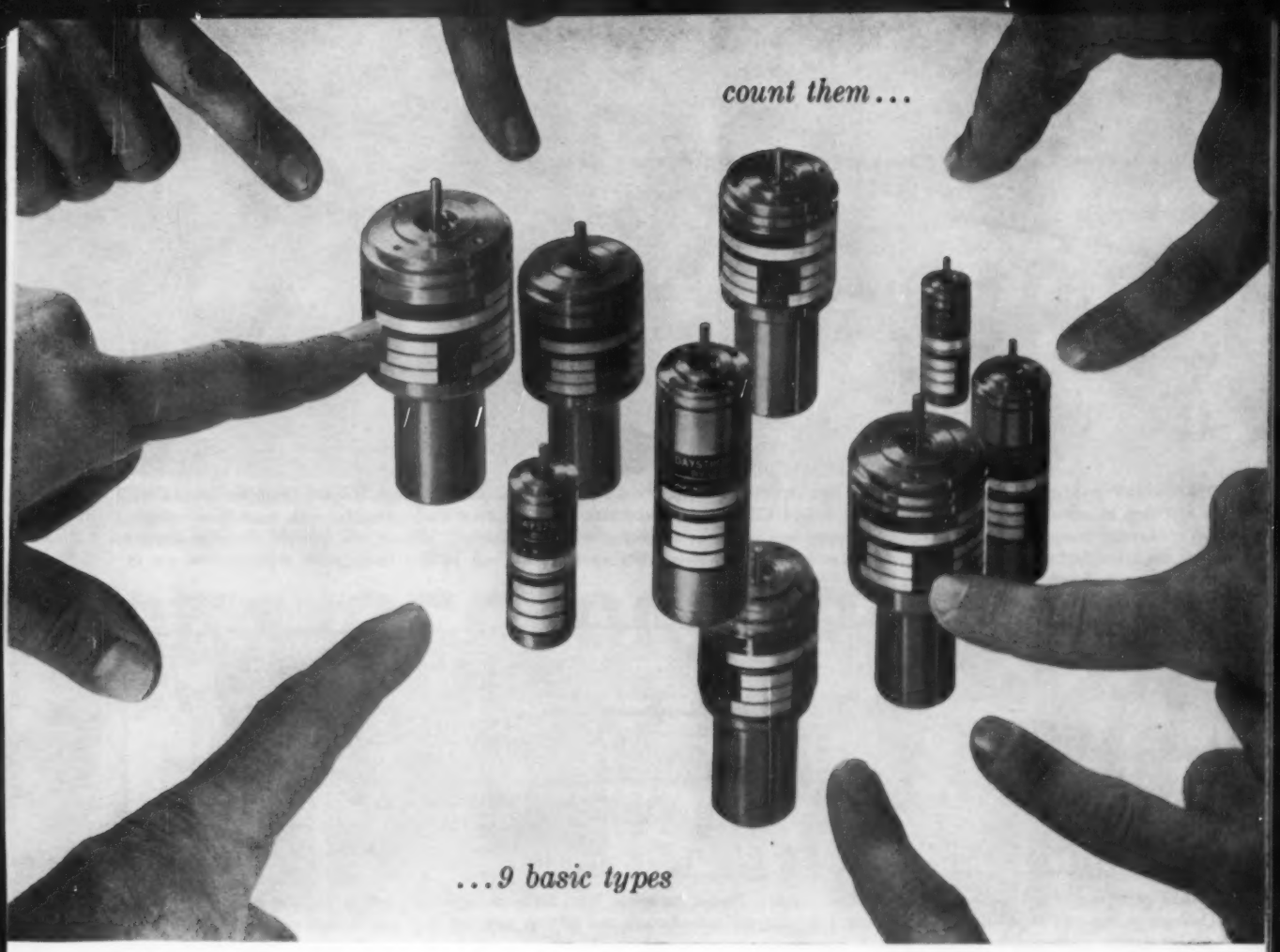
Los Angeles—Flexible, uniformly-packaged microminiature components potentially capable of simplifying and cutting the cost of assembling components into complex avionic systems were detailed here recently in a series of talks before major systems makers in the greater Los Angeles area.

Engineers from P. R. Mallory & Co., Inc., described the Indianapolis component manufacturer's family of leadless, cylindrically-shaped components (AW Sept. 5, p. 90), engineering quantities of which are now available. The components—resistors, capacitors and a rectifier—are each housed in identically shaped cylindrical, or pill-box shaped, packages. To round out the line, Mallory intends to prepare inductors and to repackage semiconductor diodes and transistors in the same format or find a semiconductor manufacturer willing to package these components in the desired micro format.

Advantages of this uniform component concept for both component



CIRCUIT package containing cylindrically shaped components is constructed by inserting components in insulative board, selective coating with seal, spray covering with three conductive layers—the first of which is masked—and then enclosing within two external protective layers.



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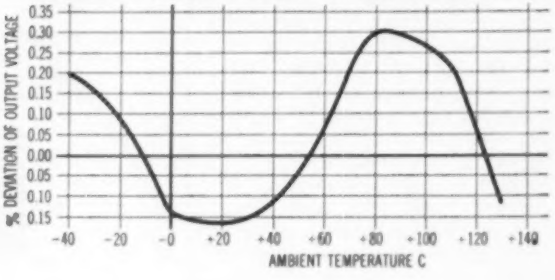

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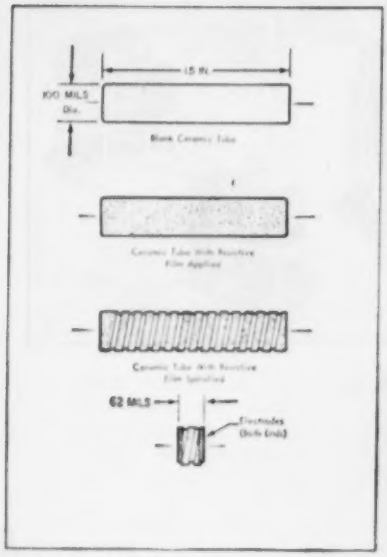

METAL oxide film resistors are cut from a metal oxide-coated ceramic tube. After spiral pattern is formed, tubes can be cut to desired length and electrodes mounted.

manufacturer and system producer are the following:

• **Production tooling** and test equipment is simple and standardized and such parts as resistors, capacitors, diodes and transistors may be handled with a minimum of equipment.

• **Product uniformity**, higher production rates and consequent lower costs passed on to the equipment manufacturer result from standardized equipment.

• **Simplicity of safely packing** and shipping batches of uniformly shaped components.

• **Reduction in amount** and complexity of equipment and problems confronting automatic assembly of components into systems.

A total of about 150 engineers at Nortronics, Hughes, North American Autonetics, Los Angeles Division of North American, Convair Pomona, Litton and Thompson Ramo Wooldridge heard the Mallory engineers explain the concept and purpose of its Unitized Component Assembly.

Marketing Plans

Mallory, acting in its traditional role as a component supplier, plans to sell uniformly packaged active and passive components in the pill-box or what it calls the pellet shape, probably without leads, for systems makers to build into their own designs. Several lines of components, each with different and as yet undecided dimensions, would eventually evolve. For smaller companies or those which don't have a subsystem packaging plan, Mallory would offer the components fully packaged into the desired circuits in its own

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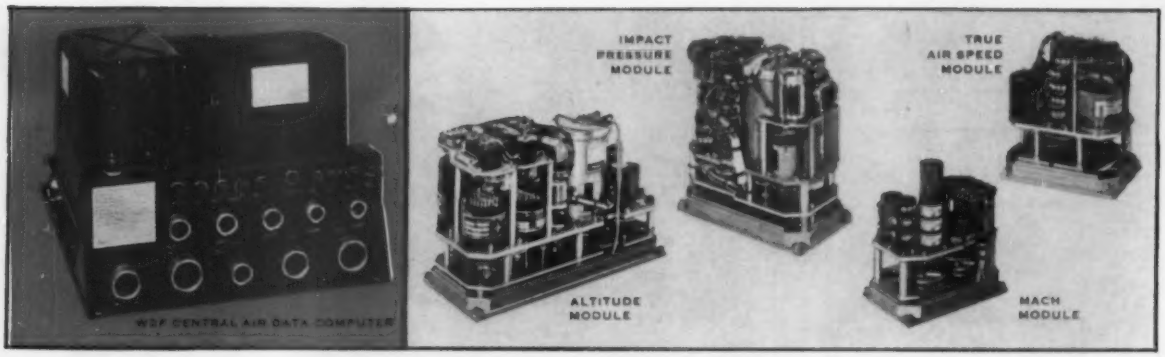

CENTRAL AIR DATA SYSTEM

HOW GIANNINI HELPED SOLVE A SYSTEM PROBLEM FOR THE GRUMMAN W2F AND A2F!

THE INPUT THE OUTPUT AND THE THREE-ARMED CADS

Before your aircraft project is ready for prototype testing, its CADS (Central Air Data System) must learn to do more tricks between input and output than a three-armed juggler, and with no chance of fumbling the crockery. No wonder project directors are often harassed by costliness of repeated revision of requirements and cost of repairs to components after delivery • But Giannini worked closely with Grumman to solve those problems with Central Air Data Systems for the Navy's new aircraft, the W2F and A2F • Here's how... **Given:** input P_T, P_S, T_T. **Required:** analog and digital outputs proportional to Mach, impact pressure, altitude, true airspeed. **The method:** Use of Giannini pressure transducers as heart of system; flexibility of design to allow changes without drastic revision; modular construction to permit quick, inexpensive replacement and repair; reliability based on Giannini's unequalled depth of experience in air data instruments, inertial instruments, servo components and related systems. **Result:** Extremely small, lightweight computers with amazing accuracy and service life • Giannini's systems capability can help define and solve your control problems, too. We're as close as your phone.

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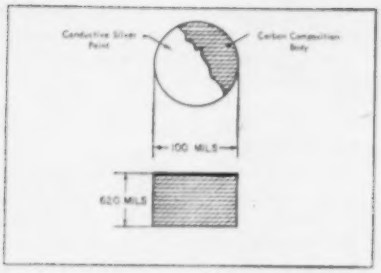
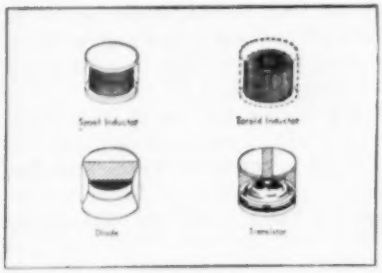


CARBON composition pellet resistor of type employed in Mallory program has silver coated end plates for terminations.

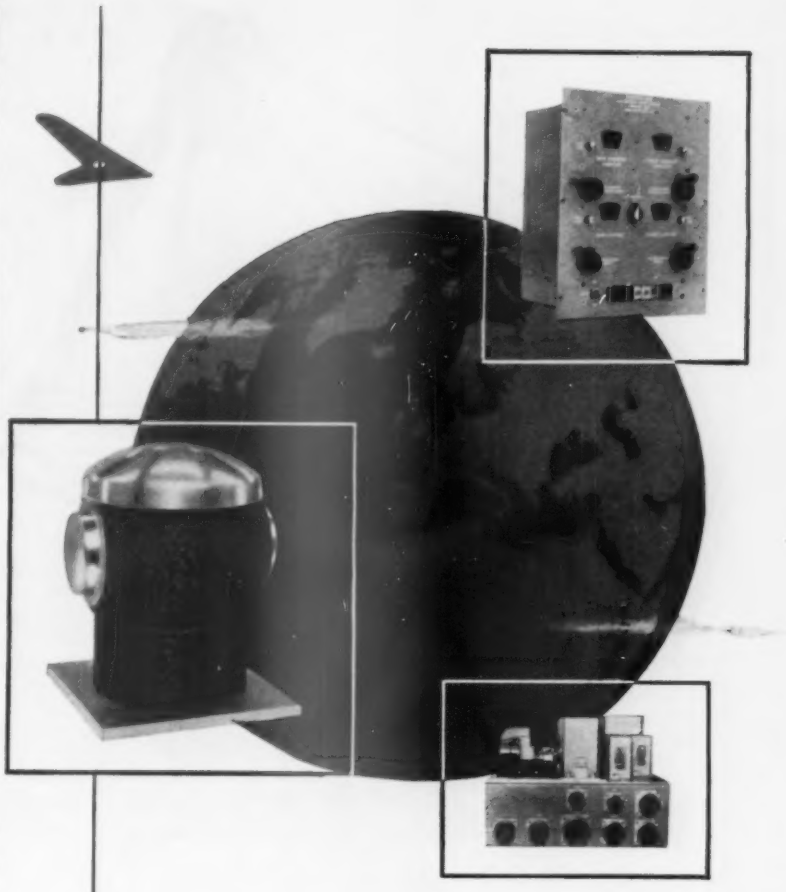
packaging arrangement, referred to as Unitized Component Assembly.

Industry interest in uniformly packaged micro components in identical formats of the same or compatible sizes which would considerably simplify assembly of systems and provide the high component densities required in space systems was expressed verbally and in recommendations adopted at a meeting of the Subcommittee on Microminiature Components of the Electronics Industries Assn. (AW Sept. 5, p. 90). Representatives of systems manufacturers at that meeting indicated that they want passive components with leads no larger than 90 mils in diameter and 60 mils in height, and active components no larger than 165 mils in diameter and no higher than 60 mils. While no recommendations were proposed for leadless components, similar formats may follow. Sample Mallory components are predominately 100 mils in diameter and 62 mils in height. Mallory will attempt to settle on dimensions satisfactory to the subcommittee and other industrial needs, according to Stanley M. Stuhlbarg, a Mallory staff engineer on its microminiaturization program.

Use of such diminutive, uniform components poses an unusual problem in polarity discrimination. Where component polarity must be known, it can be indicated, however, by the use of a magnetic material on one end of the pellet, as Hughes Semiconductor Products is doing with its experimental



CUTAWAYS indicate possible configurations of devices expected to be added to Mallory's uniformly packaged avionic components.



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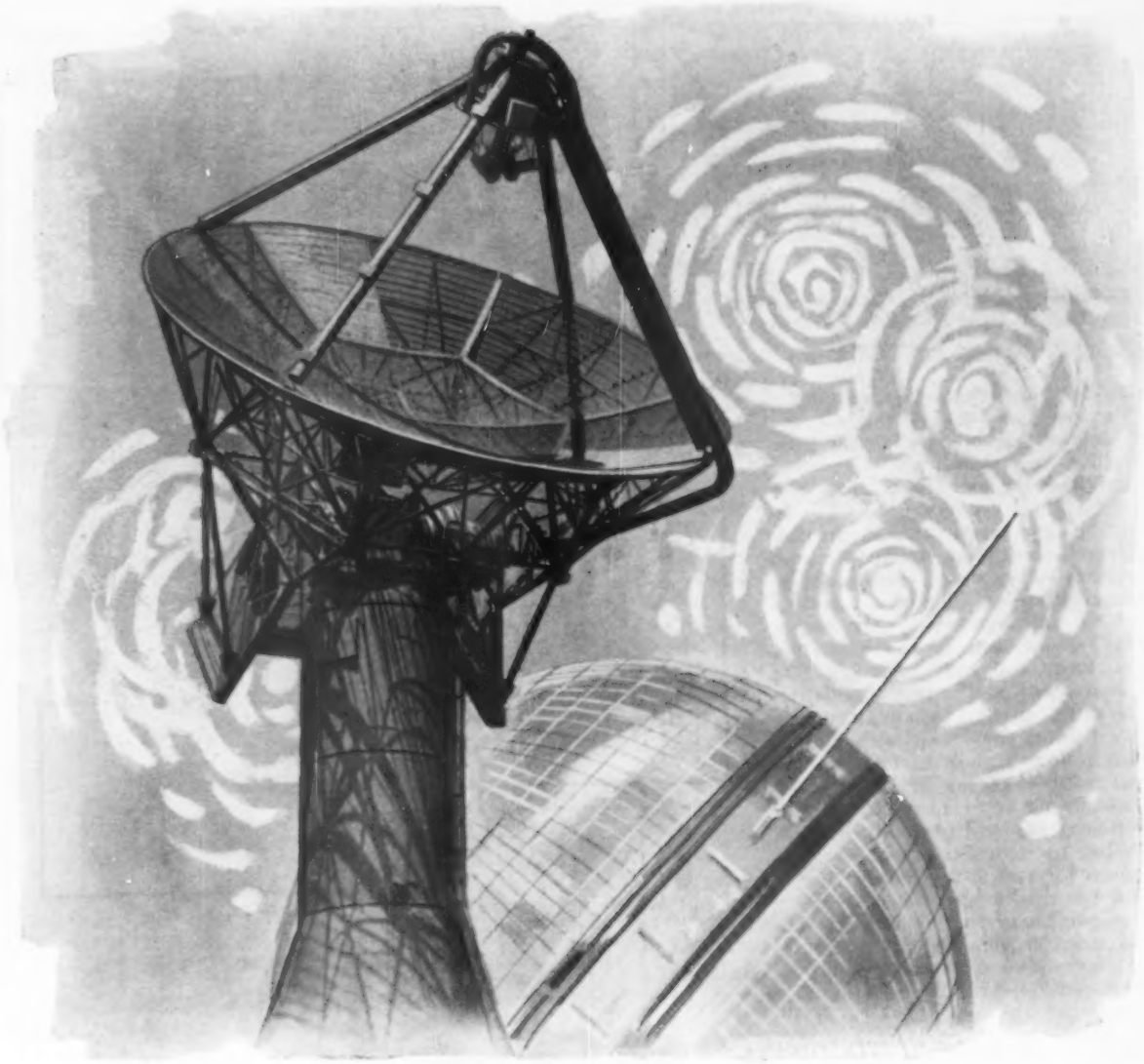

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micro diodes. Similarly, polarity might be shown with a cavity which Mallory contemplates at one end of the rectifier, or some other visually distinctive means.

Mallory, one of the oldest and more respected names in the component business, is rather cautious in its approach to microminiaturization. In response to a question asked at a meeting with Autonetics engineers, the company explained that its program is still in the formative stages, that the function of its meetings here on the West Coast are to sound out engineers' reactions to its program, initially conceived three years ago. The firm recognizes that micro components must match larger, conventional components in reliability and stability before they'll be accepted on a large scale. Consequently, extensive reliability tests, the Mallory engineers said, are now in progress at the company's research laboratories, but the results of these tests are not yet available. Reaction of engineers at one meeting attended by AVIATION WEEK appeared favorable and comments indicated on special questionnaires distributed by Mallory at the meetings were very encouraging, Stuhlbarg said.

Among the components in the Mallory uniform component line are:

• **Carbon composition resistors**—Pellet carbon composition resistors are made from carbon-conductive material mixed with a diatomaceous earth (for varying the resistivity of the mixture) and a phenolic resin binder. Conductive silver terminations at either end of the pellet are bonded to the carbon element. Several thousand carbon composition pellets fabricated to date meet MIL-R-11C, except for a voltage coefficient slightly in excess of 0.05%/volt. Characteristics of tested resistors of this type are: 0.1 watt at 70C power rating, derated to zero at 125C; 10 ohms to 22 megohms resistance ranges with ±5 and 10% tolerances; 150 v. d.c. or rms maximum continuous voltage rating, storage temperature of −65 to +85C; −65 to +125C operating temperature; ±5% to 25% resistance-temperature characteristic. One hundred mil diameter by 62-mil-high pellets, ranging in value from 5 ohms to 5 megohms with 0.1 rated power dissipation are available at $50 (set up charge per order) plus $1 per component with 30 to 45 day delivery.

• **Metal oxide film resistors**—Resistors of this type are suitable where high stability and close tolerances are necessary and high frequencies are encountered. Pellet types of which a number have been made consist of a blank ceramic tube over which a metal oxide film is deposited and then etched away in a spiral fashion. Film resistors yielded by this process are rated at 0.1 watt and will meet MIL-R-10509B. Like the carbon composition pellets, the metal oxide film resistors will be contained in 100 mil diameter, 62-mil-high packages and are available in resistance values to 20,000 ohms with price and delivery quoted on request. Eventually, film pellets in values up to 50,000 ohms with 5 and 10% tolerances are expected from 20 to 200 ohm per square films now used. Higher resistivity films, for higher resistance film pellets may emerge from present work.

• **Ceramic capacitors**—Several thousand ceramic disk capacitors made of materials like barium titanate have been fabricated. The disk is pressure-molded and fired in an oxidizing atmosphere at 1,200C to 1,400C until vitrification takes place, Mallory said. Silver paint coating applied at both flat surfaces of the disk are fired at 700 to 800C and then tin-coated metal disks are bonded to the silver in a hot oil bath. A 100-mil-dia. pellet using a 20-mil-thick ceramic disk provides a 400 picofarad capacitor. Pellet ceramic capacitors can be purchased in values up to 400 picofarads, 400 volts, in 100-mil-diameter, 62-mil-height packages; up to 1,000 picofarads, 50 volts, in 100-mil-diameter, 30-mil-high packages, and up to 4,000 picofarads, 400 volts, in 250-mil-diameter, 62-mil-height packages. The price is $50, plus $1 per component with 30- to 45-day delivery.

• **Tantalum capacitors**—Tantalum capacitors, in two cylindrical sizes and two microfarad-volt products (where selection of one factor, capacity or potential, fixes the second factor) with capacitance tolerance of ± 20%, are available. The two pellets measure 10 mils in diameter, 62 mils in height and a larger size 250 mil diameter, 30 mil height. Microfarad-volt products for the former are 10 (capacity ranging from about 2 to ½), and 25 for the latter. An accompanying drawing shows typical micro solid electrolytic tantalum capacitor with porous, sintered body tantalum anode and maganese dioxide solid electrolyte. Visual or magnetic sensing of polarity is attained by coating the anode with tin-plated nickel or steel and the cathode with gold-plated copper. Prices and availability will be supplied on request. Tantalum wafers, 200 mils square with 150 microfarad-volt products and production quantities of tantalum slugs, 70 mils diameter, 21 mils high, encased, with 40 microfarad-volt products can also be purchased from Mallory.

• **Silicon rectifiers**—In the common format, 100-mils-diameter cylinder, 62 mils in height, silicon rectifiers consisting of a silicon wafer with gold-plated slugs soldered to the anode and cathode, are available. Here again, different colored disks or varied magnetic properties of the disks provide polarity discrimination. The rectifiers have peak reverse

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voltage ratings of 400 volts, will pass 200 milliamps in the forward direction at 25C, with linear derating to zero mils current at 125C. Hermetically-sealed rectifiers with peak reverse voltage ratings up to 1,000 volts and forward currents at 200 milliamps at 25C may be feasible, according to the company.

Other pelletized components, such as toroids of about 30 microhenries and spool core inductors of about 50 microhenries, appear feasible. Unmounted microminiature tantalum electrolytic capacitors, in 15 to 150 microfarad-volts developed for the Army Micromodule program are also available and metal oxide films for wafer mounting will be ready soon.

For those companies which do not wish to build their own subassemblies, Mallory has devised its own technique, similar to one employed on an experimental basis by Hughes Semiconductor Products, for packaging components into circuit assemblies. In this packaging scheme, pellet components and terminal caps are inserted into plated through holes and slots in a ⅛-in. insulative board. The perforations are situated on a 150-mil grid system. A vinyl base paint sealing coat is then sprayed on the board through a mesh which leaves the centers of each component uncoated so that interconnection contact can subsequently be made. Three conducting coatings are applied next.

First, conductive carbon is sprayed on through a mask of the interconnecting pattern so that the silver layer which follows can make contact with the component centers. A third and final layer, carbon again, is applied. This sandwiching of the silver between the carbon layers creates a low voltage gradient and blocks migration of the silver.

An epoxy resin coating which provides mechanical strength and resistance to moisture is then dip-coated on the structure. For additional protection against moisture and to provide a smooth external coating for identifying markings, the assembly is dip-coated with black vinyl base paint.

Several circuits thus fabricated were demonstrated at the presentations. A 4:1 reduction in size was claimed for a multivibrator hybrid package containing commercially available conventional transistors and diodes and pellet resistors and capacitors. When pelletized transistors and diodes are made available, a 10:1 size reduction can be expected, according to Mallory.

Advantages claimed by Mallory for its packaging approach are:

• **Reliability**—Components are rigidly supported within the base board, protected by external coating, interconnected directly without leads. The flat package favors good thermal dissipa-

PROBLEMATICAL RECREATIONS 37

A and B live at two opposite corners of a square lot. C and D live at the other two corners. They all carry water from a spring located within the lot, which is 5 rods from A; 4 rods from B; and 3 rods from C. How far must D carry water? —*California Engineer*

If your potentiometer requirements include non-linear function units, load compensated units, special mechanical configurations, or other custom-made requirements, you ought to talk with our Potentiometer Division in Mt. Vernon, N. Y.

ANSWER TO LAST WEEK'S PROBLEM: If the height is h, after the first drop it rises ½h, next (¼)h, etc. The distance up and down then is twice (½)h + (¼)h + . . . The first drop is h feet, so the total is 3h or 30 feet.

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tion. No dip soldering of components is employed.

- **Design flexibility**—Standardized pellet sizes, layout of holes and terminal spacings allow wide choice in circuit layout.
- **Production flexibility**—Standard sizes and shapes favor automatic assembly and simplify storage of parts. Changeover in design or special designs can be achieved with a minimum of lead time and tooling expense.
- **Miniaturization**—Forty components can be housed in a single one-inch-square, ⅛-in.-thick board. Projected component densities of several hundred thousand parts per cubic foot are anticipated.
- **Throw-away maintenance.**
- **High yields and low costs.**

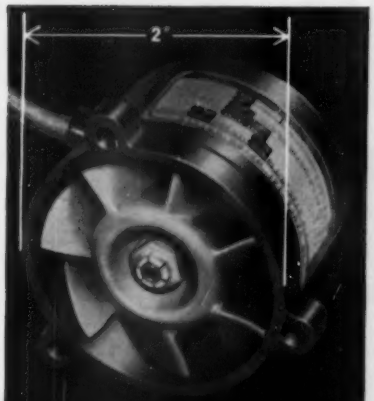
Mallory's packaging approach is similar to one developed by Hughes for which Mallory has made passive components. In the Hughes scheme cylindrical components only 50 mils in diameter and 30 mils in height are inserted into through holes along a 100-mil grid system in a 30-mil-thick Corning Fotoceram board. Hughes employs its own experimental micro diodes (AW Sept. 5, p. 90) in this arrangement.

Interconnections are made along horizontal circuit strips on one side, vertical strips on the other. Connections between the two strips are made by plated through holes, thus avoiding cross over problems.

These little assemblies can be soldered into a printed circuit board. Alternate packaging schemes considered by Mallory envisage plug-in assemblies, horizontally stacked rectangular boards, with metal terminal flexible wire interconnections.

In an effort to acquaint design engineers with its micro component approach and its Unitized Component Assembly, Mallory plans to sell low-cost evaluation kits. These would contain an assortment of components, base boards, plastic materials and masks for component interconnections and terminating leads. In this way, the engineer can actually sample the Mallory approach, see how it suits him and satisfies his needs.

Before going into full production of its micro component line, Mallory wants to see how well the components and packaging concepts are received by system design engineers. The trip here was an early step, to be followed by a tour and series of presentations at major companies on the East Coast during November. The itinerary for the next trip is not yet complete, and companies wishing to hear and see the Mallory presentation should contact Stanley Stuhlbarg at Mallory to make proper arrangements. His address is c/o P. R. Mallory & Co., Inc., Indianapolis 6, Ind.



HIGH PERFORMANCE 2-Inch Cooling Fan

AiResearch Minifan* is an extremely high performance 400-cycle AC motor-driven fan used for cooling airborne or ground electronic and electrical equipment. Model shown has a flow capacity of 53.5 cfm at a pressure rise of 3.44 H_2O, and requires only 69 watts.

Minifan operates up to 125°C. ambient. Its size and weight make it ideal for spot cooling, cold plates or as a cooling package component. The fan can also be repaired, greatly increasing its service life.

Range of Specifications

- **Volume flow: 21.5 to 53.5 cfm**
- **Pressure rise: .6 to 3.44 H_2O**
- **Speed: 10,500 to 22,500 rpm**
- **Single, two or three phase power**
- **Power: 16 to 69 watts**
- **Standard or high slip motors**
- **Weight: .36 to .48 lb.**

A world leader in the design and manufacture of heat exchangers, fans and controls, AiResearch can assume complete cooling system responsibility. Your inquiries are invited.

*Minifan is an AiResearch trademark.

THE GARRETT CORPORATION

AiResearch Manufacturing Division

Los Angeles 45, California

WHO'S WHERE

(Continued from page 23)

Honors and Elections

Federation Aeronautique Internationale has announced the presentation of the following medals and diplomas: the **FAI Gold Medal** to **Pierre Satre**, technical director of Sud Aviation and the designer of the Caravelle; the **De La Vaulx Medal** to **Gueorgui Mossolov, Gerard Muselli, Maj. Joseph W. Rogers**, USAF, and **Brig. Gen. H. Moore**, USAF, who each broke a world record during the year 1959; the **Lilienthal Medal** to **Richard E. Schreder** (USA) for establishing three new world speed records for Class D-1 single place sailplane; the **Paul Tissandier Diploma** to **Thomas G. Lanphier, Jr., Dr. K. Richard Johnson** and **Dr. Walter A. Good** (USA).

Robert L. Hall, vice president of Grumman Aircraft & Engineering Co., and **Vance Breese**, pioneer test pilot, have been awarded honorary fellowships in the Society of Experimental Test Pilots for their devotion to the advancement of manned flight. The following members of the Society were advanced to the grade of Fellow: **Alvin M. "Tex" Johnston**, Boeing Airplane Co.; **Donald P. Germeraad**, Convair Division of General Dynamics; **Melvin A. Gough**, Civil Aeronautics Board; **Carl A. Bellinger**, Republic Aviation Corp. The **Iven C. Kincheloe Award** for outstanding contributions to flight testing and development of the DC-8 and X-15 respectively awarded to **William M. Magruder**, Douglas Aircraft Co., and **Scott Crossfield**, North American Aviation, Inc. **Al White**, B-70 project pilot, was elected president of the Society for 1961.

Karl S. Day, director of dispatch for American Airlines, has been named an honorary member of the Air Line Dispatchers Assn. Mr. Day is the first member of airline management to be so honored.

Changes

Ralph V. Whitener, director general of the National Aeronautic Assn., Washington, D. C.

Kenneth W. Brown, assistant general manager, Boeing Airplane Co.'s Vertol Division, Morton, Pa.

Lt. Cmdr. Donald L. Herr (USNR, ret.), special design and planning engineer, Belock Instrument Corp., College Point, N. Y.

Giannini Controls Corp. has established an Astromechanics Research Division in Buffalo, N. Y., and **Melvin B. Zisfein** has been appointed manager.

Richard W. Benfer, department head and director, Bell Telephone Laboratories' recently established Kwajalein Island Field Station, responsible for the Nike Zeus test program. **Louis H. Kellogg** succeeds Mr. Benfer as director of Bell Telephone Laboratories' White Sands (N. M.) installation.

Walter S. Attridge, Jr., head, Weapons Control and Sensor Systems Department, Mitre Corp., Bedford, Mass.

William G. Robinson, corporate director of public relations, Cessna Aircraft Co., Wichita, Kan., and **Rankin L. Griesinger**, manager of public relations-Marketing Division.

INTRODUCING COLVIN Type 8416 PRESSURE TRANSDUCER

for High Pressure Ranges absolute, differential, gage 0-600 psi to 0-15,000 psi

FEATURING:
Small size: 1 inch diam.
Potentiometer Output
Lightweight: .3 pound
Performance in severe vibration, acceleration and shock environments

Write us regarding your transducer requirements.

COLVIN LABORATORIES, INC.
364 Glenwood Avenue
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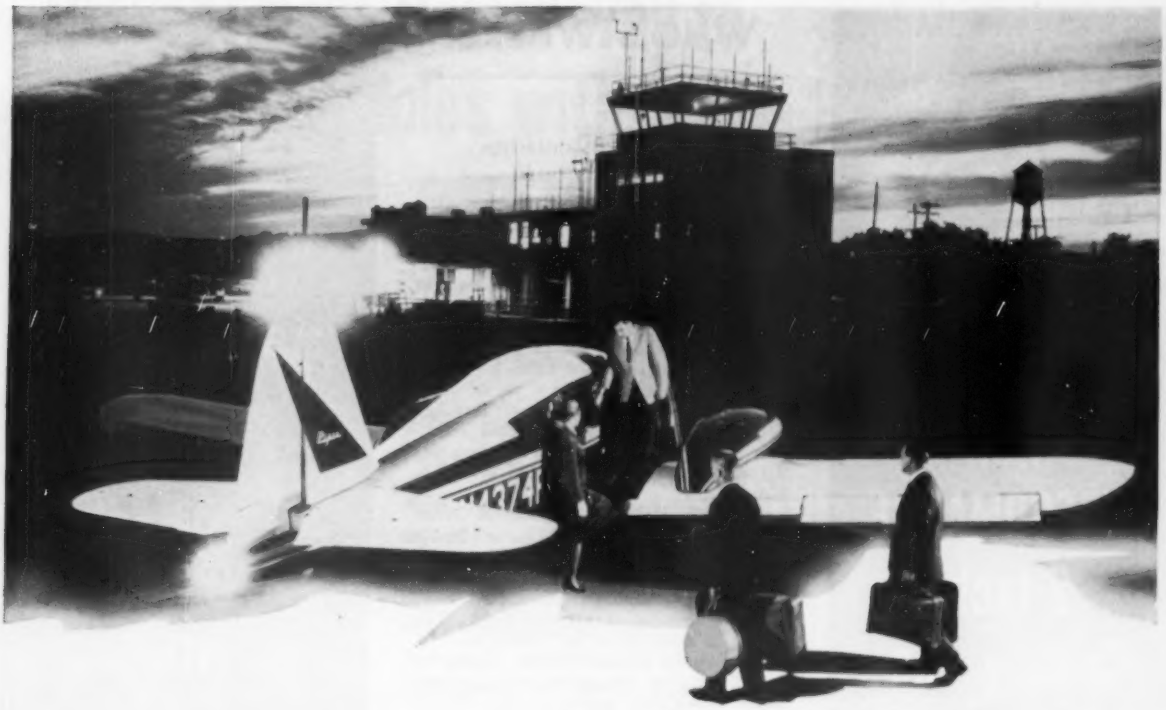

Pick a Piper Twin

PIPER AZTEC. Cruises over 200 mph with range up to 1,400 miles. Powered by two Lycoming 250 hp engines, has highest single-engine ceiling of any airplane in its class carrying a similar payload. Carries five passengers in luxury of super-quiet cabin. Selected by U.S. Navy for utility transportation duty. **$49,500.**

Night time's flight time with a twin-engine Piper Apache or Aztec, each *practically priced* to bring the wonderful advantage of *night* and day operations within reach of many present owners of single-engine airplanes.

Both the Apache, world's most popular executive twin, **and the Aztec,** Piper's newest, fastest, largest airplane, are priced in a class by themselves, each many thousands of dollars less than other aircraft with similar performance. A very simple reason explains this. Many common parts and components used in both models... plus the highest rate of twin engine production of any company... result in manufacturing efficiency and economies which keep the prices down, with no compromise in dependability or quality.

If you're ready to increase the utility of your aircraft, consider an Apache or Aztec. You'll find either of these distinguished Piper twins surprisingly easy to fly, forgiving in the true Piper tradition and miserly on maintenance. Sunset will lose its meaning; you'll love flight at night with two wonderful, dependable Lycomings purring away.

Pick your Piper twin today. *See your Piper dealer for demonstration or write for Apache/Aztec brochure, Dept. 11-W.*

SINGLE-ENGINE EASE. Apache and Aztec operate with ease on one engine. Double dependability of fine Lycoming engines plus optional dual electrical, dual hydraulic, dual vacuum systems assure safe, reliable transportation.

APACHE MODEL G. Newest, finest version of the world's most popular executive twin. Carries four or five in beautiful, newly-styled cabin with new rear picture windows added. Dependability amply proved by more than 100 trans-Atlantic delivery flights. Two Lycoming 160 hp engines, cruises over 170 mph. **$36,990.**

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LEASE OR FINANCE. Capital-conserving lease or finance plans are employed by many Piper users and can easily be worked out to suit your own individual requirements.

MORE PEOPLE HAVE BOUGHT PIPERS THAN ANY OTHER PLANE IN THE WORLD

PRESSURIZED Lockheed Super 26 has an enlarged cabin. FAA has granted the plane a supplementary type certificate.

B-26 Conversion Has Rebuilt Fuselage

Ontario, Calif. – Federal Aviation Agency granted Lockheed Aircraft Service a supplementary type certificate for its pressurized Lockheed Super 26 after 13 hr. of FAA flight testing (AW Oct. 10, p. 118).

The Super 26 is an executive transport modification of the B-26, modified by Lockheed Aircraft Service under contract for Mesta Machine Co., Pittsburgh, Pa.

The military fuselage was discarded and replaced with an enlarged cabin structure. Cabin and cockpit are pressurized. In flight tests the Super 26's pressurization system held a 5,000-ft. cabin altitude at 14,500 ft., and a cabin altitude of 8,000 ft. at 20,000-ft. altitude.

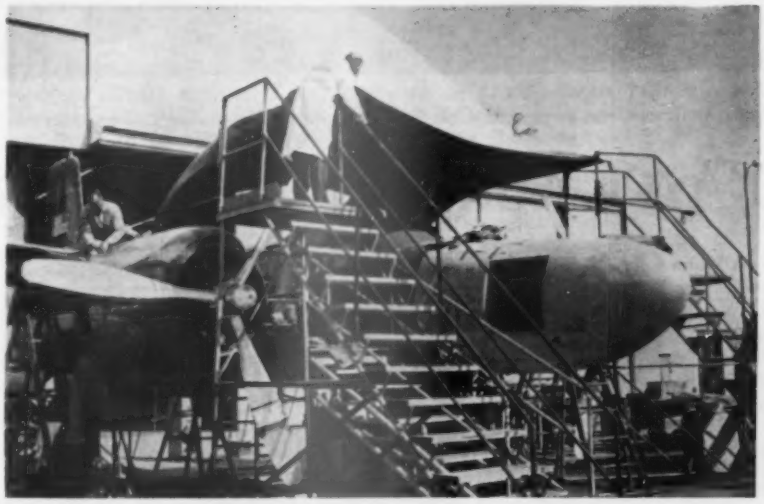
Acoustical insulation surrounds the cabin and cockpit.

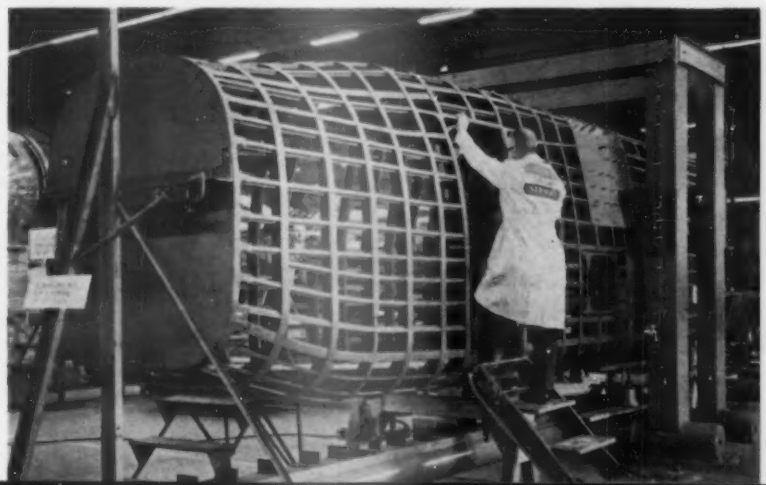
Thermostatically-controlled heating and air conditioning systems maintain desired temperatures on the ground and in the air.

The rear wing spar was removed so that it no longer passes through the fuselage. It was replaced by a forged steel fuselage ring to which wing attachments are fastened.

The modified cabin is 22 ft. long, 6 ft. high and 4 ft. 8 in. wide. Also included in the modification are a lavatory, installation of an electrically powered Air-Stair door, Constellation-type windows, heated windshield and auxiliary baggage space behind the cabin.

The Lockheed-designed and manufactured glass fiber nose contains electronic equipment and baggage space. Vertical stabilizer has been enlarged for improved longitudinal stability.





GLASS-FIBER nose on Lockheed's Super 26 executive transport provides cargo space and houses avionic equipment. The Air-Stair door (below) is electrically actuated. The cabin section built by Lockheed is 22 ft. long, 6 ft. high and 4 ft. 8 in. wide.

354 AIRCRAFT attended FAA's second annual fly-in at National Aviation Facilities Experimental Center, Atlantic City, N. J. Air traffic congestion was so great that the tower relinquished control to mobile trailer near active runway threshold.

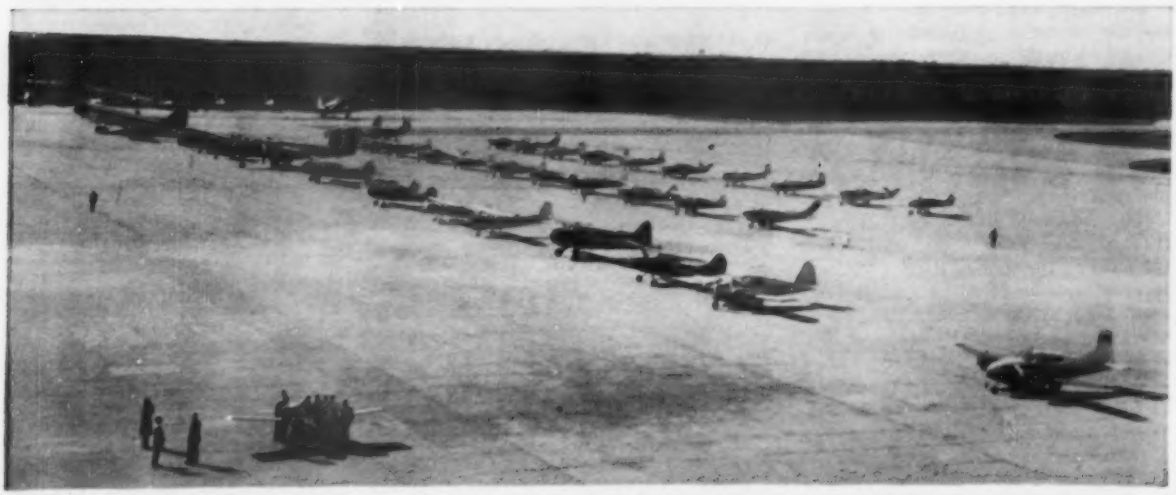
FAA's Annual Fly-In Draws 354 Planes

Atlantic City, N. J.—All the gadgetry in the control tower at Federal Aviation Agency's vast experimental center here couldn't cope with the swarms of light aircraft that descended when FAA staged its second fly-in for general aviation buffs.

In the hour of peak activity, a lightplane was touching down at National Aviation Facilities Experimental Center every 40 sec. Traffic tower counters disclosed that 354 aircraft flew in for the affair, most of them within a 5-hr. timespan. Last year, FAA's first fly-in attracted 232 aircraft to this former Naval Air Station.

Inside the control center overlooking NAFEC's sprawling runway complex, seven controllers gave up after trying for most of a morning to answer the conflicting calls of inbound pilots in search of landing instructions. They relinquished control to two colleagues in a mobile trailer stationed near the threshold of the active runway. Over several frequencies, they said:

"Attention all aircraft landing At-

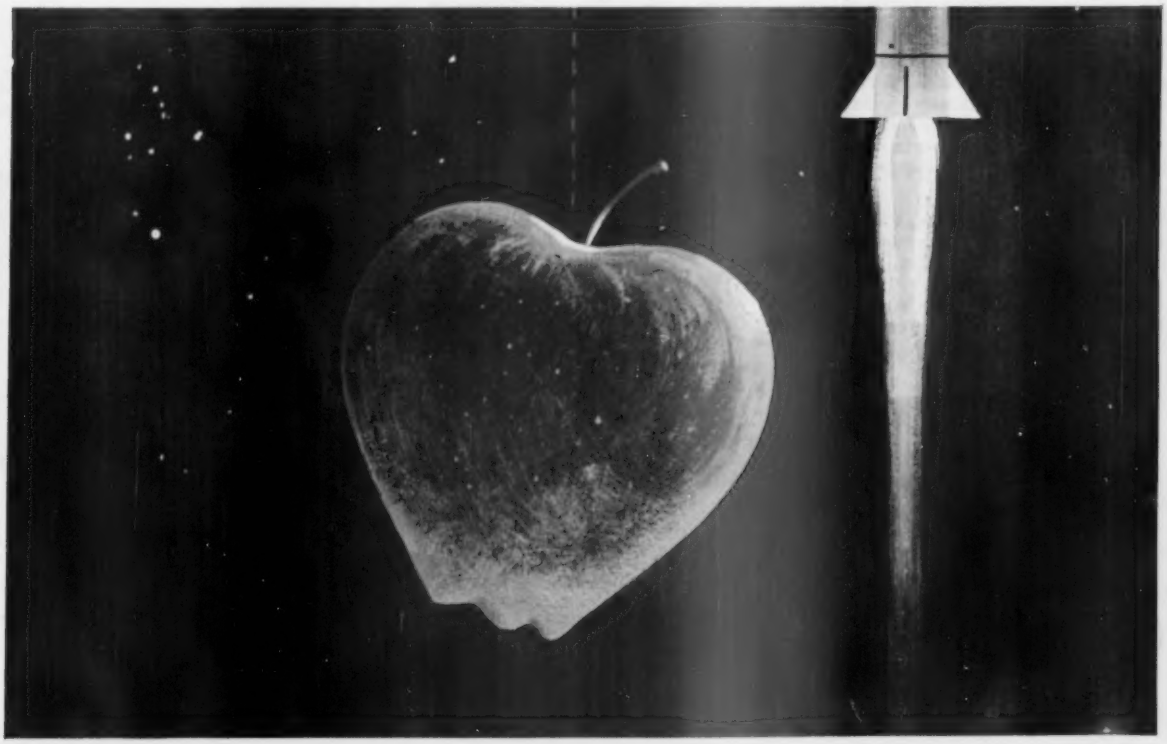


LATECOMERS to NAFEC fly-in are parked on apron. An Avions Fairey Tipsy Nipper (left foreground) draws small crowd.

BUT, SIR ISAAC, WE'RE NOT GUIDING APPLES!

Until a ballistic missile is in free fall, our inertial guidance systems must be able to account for both rocket thrust and gravity. Making them this smart is a tough job, but we hit the mark so well on Thor that all of this country's long range missiles will soon be guided inertially. If you would like to help us keep pioneering new guidance systems, and have a BS, MS or PhD in Physics or Math, or an ME or EE, please contact Mr. B. A. Allen, Director of Scientific and Professional Employment, 7929 S. Howell Ave., Milwaukee 1, Wisconsin.

AC SPARK PLUG ⚛ THE ELECTRONICS DIVISION OF GENERAL MOTORS



More people will travel further in a shorter time—men will move in geocentric orbits at 18,000 mph—space probes will shrink our celestial environment. To accomplish these things, the time between research and application engineering will shrink dramatically.

Convair believes that the full potential of Technology in the Sixties will be realized through ideas originating in the minds of creative scientists and engineers. To implement this conviction, Convair-Fort Worth is pursuing an active research program in the engineering and physical sciences.

A position on the staff of the newly formed Applied Research Section offers opportunity rarely found for physicists and engineers at the doctorate level. Research programs in the fields of astrophysics, relativity, gravitation, physics of materials, and geophysics are in the formative stages of planning and activation. Active and mature programs in electronics, space mechanics, and thermodynamics are underway.

If you can qualify, a position within this section will offer unlimited growth potential. For further information, forward your personal resume to Dr. E. L. Secrest, Chief of Applied Research, Convair-Fort Worth, P. O. Box 748 A, Fort Worth, Texas.

CONVAIR/FORT WORTH
CONVAIR DIVISION OF
GENERAL DYNAMICS

lantic City. Do not transmit except in emergency. Landing left traffic Runway 35. Wind north-northwest at 20, gusts to 25. Altimeter 30.18. Watch for a red or green light on final. After landing, clear the runway to the left at first intersection."

The pilots—most more familiar with towerless airports than with well-disciplined terminals such as NAFEC—had few problems finding their sequence in the rectangular pattern, even though their queues on final sometimes stretched to eight aircraft.

Parked wingtip-to-wingtip on the grass between NAFEC's runways at day's end were 317 single-engine aircraft and 37 twins. Although 23 types were represented, vintage planes, commercial helicopters and radical designs were conspicuously absent amid the Pipers, Cessnas, Beechcrafts and other prevalent designs.

Purpose of the fly-in was to acquaint general aviation with NAFEC's research and development programs.

NAFEC's Convair C-131B avionics testbed was on static display, as were a Grumman F9F-8T and Grumman Gulfstream testbed.

Dr. James L. Goddard, civil air surgeon, Bureau of Aviation Medicine, told the fly-in guests that FAA expected to somewhat ease pilot medical restrictions for certain types of disabilities—for example, mild diabetic cases.

Exhibits set up in the laboratories and hangars at NAFEC, and equipment demonstrations, included:

- **Runway light installation** displays, including semi-flush pancake lights, Elfaka flush-grid lights, MC-2 narrow-gage lights and both fluorescent and incandescent flood lights.
- **Visual glide slope** demonstration, showing the British RAE visual glide slope installation (AW Oct. 10, p. 97).
- **Distance measuring equipment** (Tacan).
- **Visual conspicuity** studies of aircraft paint.
- **Aircraft anti-collision lighting** studies.
- **On-line computer laboratory.**
- **Bell 300 telephone** communication program.
- **AGACS** automatic ground-to-air communications development.
- **Approach lighting configurations.**
- **Runway visual range and approach** light contact height equipment.
- **Traffic control** operations.
- **Dalto approach-landing-takeoff** simulator.

Bus trips were arranged so visitors could see NAFEC's doppler VOR installations, aircraft height and surveillance radar installation and FPN-34 surveillance radar facility.

Fly-in guests also were taken to see runway lighting installations and the visual glide slope installation on Runway 13.

STRUCTURAL DESIGN ENGINEERS

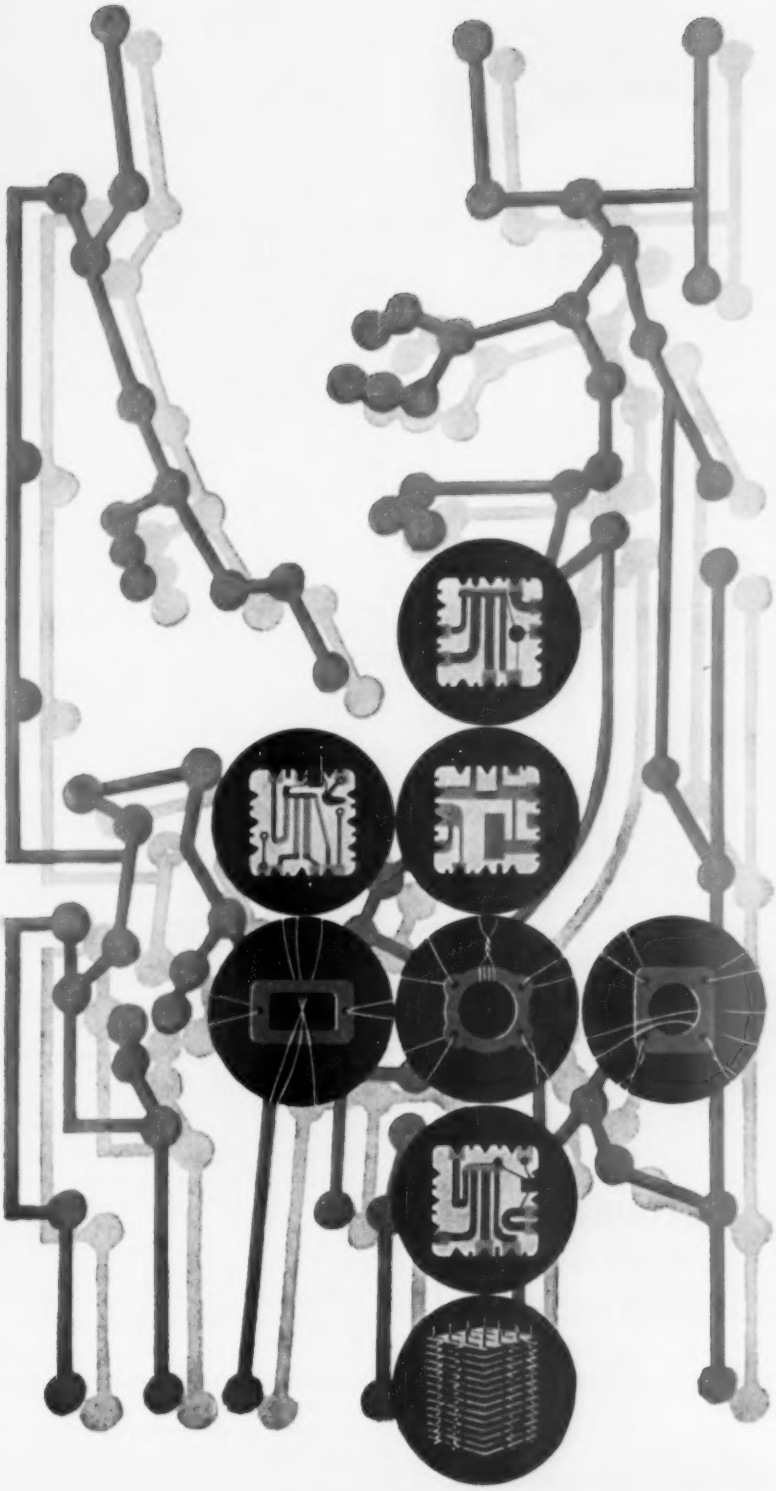
Two years engineering college plus experience desired. Will be engaged on wing and fuselage design.

STRESS ENGINEERS

Rigorous design requirements necessitate extensive structural investigation of the influence of high temperatures and unconventional external loadings. Stress engineers concerned with such structures will have the opportunity to utilize their technical knowledge to the fullest extent in the development of new analysis methods. Experience plus degree preferred.

For more information please write to: Mr. A. K. Bowman, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

THE LOS ANGELES DIVISION OF
NORTH AMERICAN AVIATION, INC.



ADVANCED COMPUTER RESEARCH AT LOCKHEED

Challenging new concepts in the computer field are being investigated at Lockheed's Missiles and Space Division research laboratories in Palo Alto, California. Important progress is being made in pure and applied research as well as in the development of new and unusual design concepts.

Advanced research programs are being carried on in such areas as:
Switching theory • Modular codes • Logical design • Mechanical language translation • Digital system theory • Ferrite-wire logic circuits • Tunnel diode circuits • Microwave digital techniques • Magnetic thin films • Micro circuitry

Engineers and Scientists who are able to make contributions in these areas are invited to write to: Research and Development Staff, Dept. J-17B, 962 West El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

Lockheed

MISSILES AND SPACE DIVISION

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SYSTEMS ENGINEERS

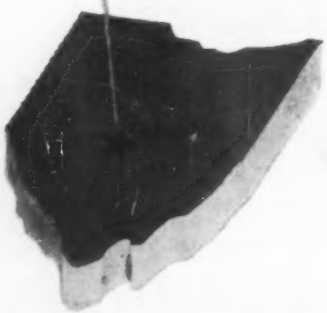
here is your opportunity to join one of the most complete centers of advanced systems capability

The Columbus Division of North American Aviation is a center of *total* systems capability. It is the designer and builder not only of aircraft—such as the A3J Vigilante and the T2J Buckeye—but also of missiles, radio/radar telescope systems, seat ejection systems, and other diverse products. The Columbus Division is also the center of extensive advanced R&D projects. Here, there are unlimited opportunities to contribute to advanced technology—and to forward your own career.

Currently, the Columbus Division has openings for SYSTEMS ENGINEERS. These engineers will assume responsibility for airframe electronic systems. To qualify for these positions, men should have a background in one or more of the following fields: ECM, radar, packaging, reliability, antennas, data processing, reconnaissance or associated systems and components, and design of logic digital computers. They should have a BSEE, or the equivalent, plus three years experience.

If you meet these qualifications, and seek an opportunity to advance your career, please contact us right away. Send a brief resume in confidence to:

Mr. J. A. Hitchcock
Engineering Personnel, Box AW-387
North American Aviation, Inc.
Columbus, Ohio



THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Flying Cranes Urged On Soviet Railroads

Moscow—Official Russian government newspaper Izvestia has criticized the USSR's Ministry of Transport Construction for failing to order the use of helicopters as "flying cranes" to speed the electrification of Soviet railroads.

According to Izvestia, many railroad lines due for electrification carry so much traffic that only brief periods between train movements are available for electrification work which depends on rail transport and equipment.

"It would seem that under these circumstances it would be most expedient to use helicopters, since they can operate independently of train movements. Directors of the Magnitogorsk Communications Construction Trust estimate that the cost of erecting a railroad electric powerline support can be cut from 600-800 rubles to 300 rubles by using helicopters. But the Ministry of Transport Construction, which is in charge of railroad electrification, moves very unwillingly in this regard."

Izvestia pointed out that "flying crane" helicopters have been used very successfully in building Russian power transmission lines and gas pipelines through difficult terrain. It said helicopter designers at the M. L. Mil plant had provided assurance that there are no technical obstacles to prevent employment of standard helicopters (primarily Mi-4s) equipped with load suspension gear on railroad electrification projects.

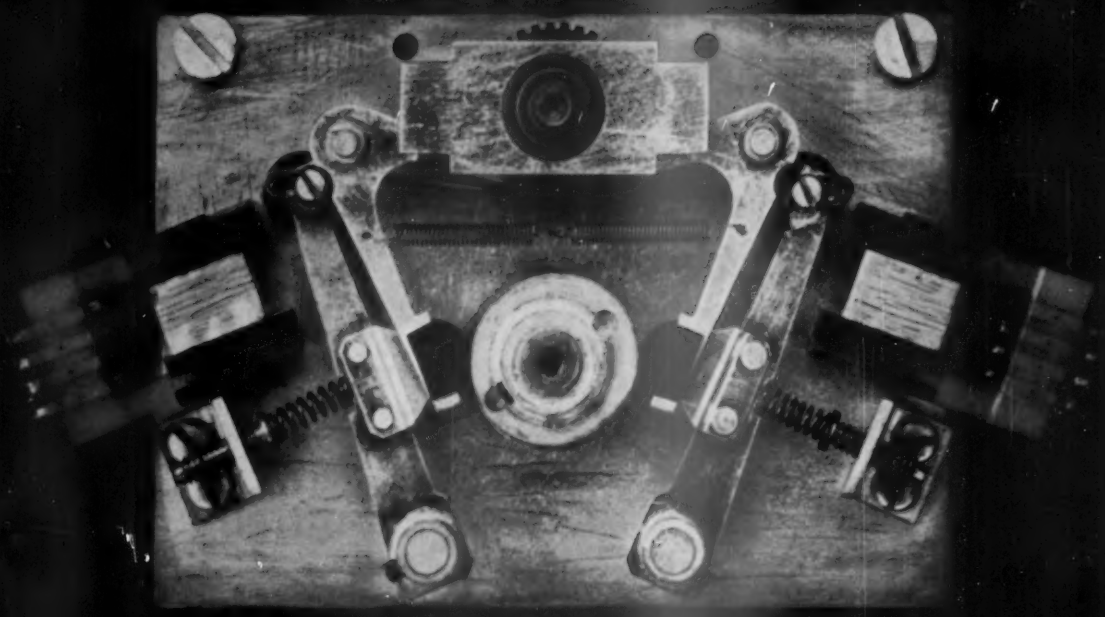
The newspaper scoffed at fears expressed by the Ministry of Transport Construction that "flying crane" helicopters are unsafe for railroad electrification work because of insufficient pilot visibility and inadequate stabilization of suspended loads. These problems, Izvestia said, are being solved.

PRIVATE LINES

Meyers Aircraft Co., Tecumseh, Mich., will assume production of its 145 model, a two-seat, retractable gear, all-metal business airplane, with the first model off the assembly line by the end of January, 1961. Meyers dropped the 145 several years ago in favor of its larger, four-place 200. The 145 is 21 ft. 10 in. long, with a wingspan of 30 ft., and is powered by a 145 hp. Continental engine. Cruising speed is 162 mph. at 7,500 ft.

T. Eaton Co., Ltd., largest department store organization in the British Commonwealth, will be the first Canadian company to fly the Lockheed Jet Star.

Opportunities in Systems Development



Harnessing a new principle of incremental drive

Here is a new way to convert high-speed shaft motion into precise increments, stepping forward, backward or oscillating alternately. It was developed from scratch by IBM engineers.

This truly clutchable incremental stepper provides precise control of acceleration, runs at high speed, and has great accuracy.

The Method of Attack

IBM engineers tackled the problem of high-speed, start-and-stop motion on a theoretical basis. They analyzed the loads and accelerations involved, and decided what masses and forces would be practicable. The stepper they developed is not only more versatile and efficient than alternate methods but also gives greater life expectancy, requires no elaborate oil bath, and is easier to package into a machine assembly.

Whether it's a problem in mechanics, electronics or physical science, IBM engineers are encouraged to attack problems from fresh viewpoints. Depending on your field, you might be interested in the advances IBM people are making in magnetics, microwaves, semiconductors and inertial guidance. In every area of research and development, you will find IBM receptive to the individual who wants to make significant contributions.

How to Start an IBM Career

Right now, there are several key openings in IBM's expanding research and development staff. If you have a degree in engineering, mathematics or one of the sciences—plus experience in your field, write, briefly describing your qualifications, to:

Manager of Technical Employment
IBM Corporation, Dept. 524W4
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Outstanding openings now for qualified

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for development projects and for production projects

SOLAR OFFERS PERMANENT employment in a relatively new and exciting field with a tremendous growth potential. Solar is a vigorous, medium-size company founded in 1927. Solar gas turbine engines have already won an international reputation. There is an excellent balance between commercial and military contracts.

Living in San Diego is delightful. This favored area is smog-free, with the finest climate in the United States, and has unmatched recreational and cultural activities.

Applicants with BSME or AE plus 3 or more years experience are preferred. Inquire *now* for responsible positions in our rapidly expanding programs in gas turbines and airborne controls. Replies will be kept confidential. Write, giving resume, to LOUIS KLEIN, Department E-701, Solar Aircraft Company, 2200 Pacific Highway, San Diego 12, California.

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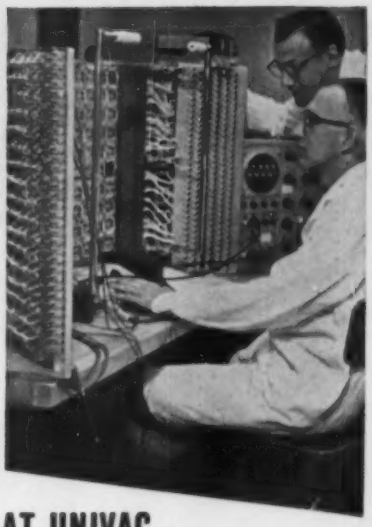

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OPPORTUNITIES FOR

Transistor Circuit Designers

Immediate openings are now available at Remington Rand Univac for Transistor Circuit Designers, as well as other professional personnel who are seeking a career opportunity.

Investigate these opportunities and make your step toward enjoying the many benefits of a position in Univac's *atmosphere of achievement.*

- **TRANSISTOR CIRCUIT DESIGNERS**

Applicants should have an electrical engineering degree with a minimum of 3 years actual hardware experience in the development of data processing utilizing solid state devices.

Other openings include:

- COMMUNICATIONS ENGINEERS
- SERVO-ENGINEERS
- SYSTEMS ENGINEERS
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- PRODUCTION ENGINEERS
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Send resume of education and experience to:
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DIVISION OF SPERRY RAND CORPORATION
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There are also immediate openings in all areas of digital computer development at our other laboratories. Inquiries should be addressed to:

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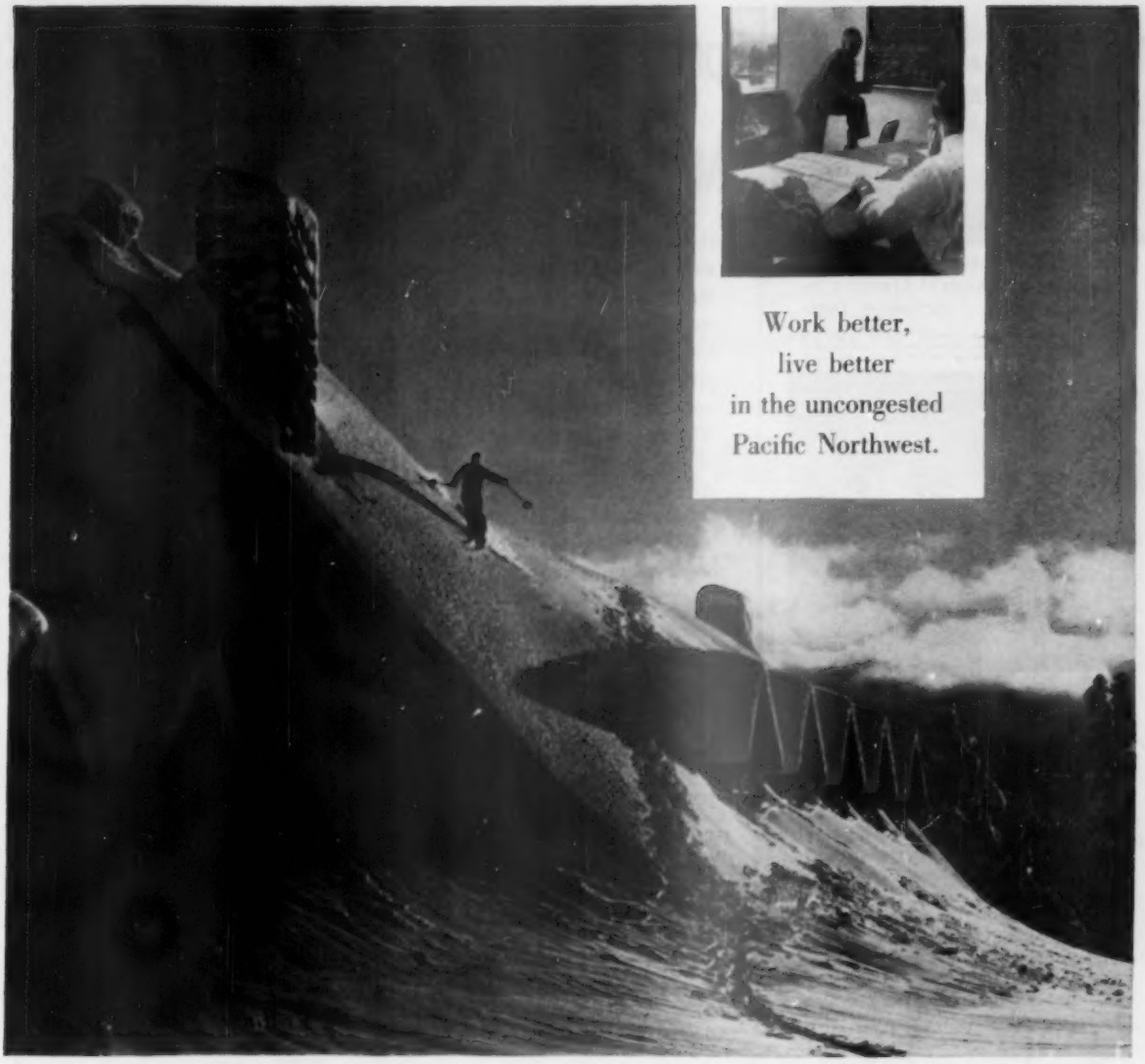
REMINGTON RAND UNIVAC
1900 West Allegheny
Philadelphia 29, Pa.

D. CLAVELOUX, Dept. D-10
REMINGTON RAND UNIVAC
Wilson Avenue
South Norwalk, Conn.



Work better,
live better
in the uncongested
Pacific Northwest.

Skiing on roof of mountain lodge two hours from mild, evergreen Seattle

Immediate, long-range openings at Boeing for

STRUCTURAL, MECHANICAL AND AERONAUTICAL ENGINEERS

These openings are on expanding projects concerned with aircraft of the future. They offer qualified engineers stimulating assignments on advanced commercial aircraft programs now under way at Boeing's Transport Division. In addition, training assignments are available, on a selective basis, to engineers in other fields who wish to apply their capabilities to aircraft work.

At Boeing you'll be working with the designers and builders of the world famous 707 and 720 jetliners. You'll enjoy the advantages of a professional climate that's conducive to deeply rewarding achievement. You'll have an opportunity to speed your career progress by taking graduate studies, at company expense.

The Boeing Transport Division is located in the uncongested Pacific Northwest, noted for mild year-round climate, nationally famous recreational facilities, excellent schools and housing, and healthful outdoor Western living for the whole family.

TRANSPORT DIVISION **BOEING**

MAIL COUPON TODAY

Mr. Robert W. King, Transport Division, Boeing Airplane Company, P.O. Box 707 - 9PA, Renton, Wash.

NAME

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DEGREE(s)

FIELD OF INTEREST

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FPD PROFESSIONAL EMPLOYMENT NEWS

Published by the Flight Propulsion Division of General Electric in Cincinnati, Ohio / OCTOBER, 1960

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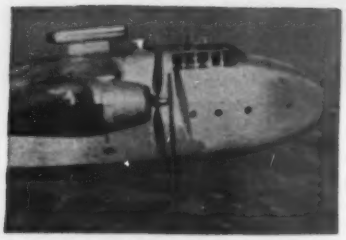

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LETTERS

Reply to Medaris

Recent comments by the press have publicized Army Gen. Medaris and his book "Countdown for Decision," which is highly critical of other military services and the Department of Defense.

As the principal civilian responsible for the Army's Research and Development activities, I can objectively state that the views of Gen. Medaris are not wholly shared by responsible senior military officers and civilians in Washington. Certain of his specific statements regarding the improper direction and management of major programs, such as Saturn and Nike Zeus, are inconsistent with the facts, and his comments on U. S. intelligence activities are both inaccurate and particularly inappropriate from a man entrusted with highly classified data.

Gen. Medaris' vicious personal attack on Dr. York, even while he is recovering from a heart attack incurred during his thankless job as Director of Defense Research and Engineering, is something less than impressive. A primary responsibility of Dr. York's job involves the making of early and difficult decisions with respect to the many conflicting, although sincere, demands of our three services, each pressing for particular projects and weapon systems which must be considered in the total context of our national policy as it evolves from our complicated democratic process in an era of rapidly changing technology.

Such projects as Gen. Medaris' own proposed $13 billion program to initiate military operations on the moon, as well as projects of comparable fantasy periodically suggested by others in the Pentagon, confirm our need for sound centralized civilian control of programs and policy by the Department of Defense in its expanding research and development effort.

Under the splendid leadership of Defense Secretary Gates we now have developed a fine cooperative relationship between the Assistant Secretary of Research and Development of both the Navy and Air Force and my office. Working in close harmony with our respective military counterparts, the Defense Department's Research and Engineering Policy Council, of which we constitute the members, presents an excellent example of true service unification which could be profitably duplicated at other levels within government operations.

This country is indeed fortunate in its current high caliber of military and civilian leadership that we have in Washington, and in my 25 years of industrial service I have never met a more dedicated group of associates.

Our management decisions are of an increasingly difficult and complex nature.

I appreciate this country's need, and that of Congress, for the development of an educated public opinion in the areas of national defense, and I am sure Gen. Medaris is highly motivated by such objectives.

We must have constructive and objective ideas relating to our national strategy and government organization, improved cooperation between our military services, and good experienced people willing to stay on the Washington scene. While controversial books such as Gen. Medaris has written stimulate thought, the lack of objectivity and personal invective greatly reduce its effectiveness and tend to render impractical any future contribution to national defense by the author.

RICHARD S. MORSE
Director of Research and Development
Department of the Army
Washington, D. C.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Satellite Threat

There have been occasions in the past when I have viewed the contents of your editorials as your own brand of threat to our Department of Defense. Usually these have taken the form that "if something isn't done about 'it,' dire things are going to happen to the nation." Many of these arguments I have viewed as subjective, so that the opinion expressed in editorial form was at least controversial.

Your "Satellite Blackmail" appearing in the July 25 issue, however, strikes me as its own form of blackmail of the Department of Defense. You state that our efforts to produce an anti-satellite weapon system have run into a "fiscal straitjacket," and that the new presidential candidates better take heed of your warning so that the nation may not find itself defenseless against the Russians.

I hold that this bogeyman of yours is just your own way to wring another slice of the defense budget for the various contractors in the "air" defense business. After all, what is good for the aviation business is good for AVIATION WEEK. Your technical advisers have failed to tell you that, at least three years ago, this very problem was studied and that recommendations were made. I was, at that time, a member of the team that conducted the study and it was my particular task to determine the nature of the threat.

I can assure you that there is nothing inherent to the concept of a satellite launching base that poses any problem different from the interception of an ICBM, except, perhaps, in the omnidirectional possibility of attack. Therefore, I submit that the notion of their nuclear warheads in orbit would be just as disdainful to the Soviet weapons designers as it would be to us. There is very little difference in the return trajectory of an ICBM that reaches near-orbital speed and that of a re-entry body that can be decelerated from orbital speed to make the return trip to earth. The latter simply suffers by having to have a much more complicated guidance and control system. Ergo, since we are engaged in learning how to intercept an ICBM, we are, at the same time, working toward the defeat of a satellite threat such as you describe.

What I object to is your effort to snatch at any excuse to warn of terrible consequences if we don't spend untold million on this, that, or the other project. I think it's a dishonest appropriation of the taxpayer's money. And if anyone should share your view for the sake of his own economic welfare (from the short-sighted standpoint) it should be me, because I'm part of that same defense contractor complex that pays my salary.

about 'it,' dire things are going to happen

Lockport, N. Y.

Lualdi L.59 Speed

I would like to bring to your attention an article in your magazine on p. 92 of the Aug. 1 issue.

I refer to the maximum speed of the Lualdi L.59 helicopter. This (160 mph.) is rather hard to believe since Bell's HU-1A just set a world record in the neighborhood of 150 mph. recently. It seems to me that perhaps the writer meant that its maximum range was 160 mi. Please clarify.

G. C. ERBECK
Capt., Armor
150th Aviation Co.
NJARNG

(The Lualdi caption was sent from Europe, and inadvertently the kilometers per hour were not converted to miles per hour. The correct value is 160 kph., which works out to about 99.4 mph.—Ed.)

Diode Reliability

Mr. Philip J. Klass' article entitled "Digital Computer Reliability Grows," published in the Sept. 19 issue, was of extreme interest to us at the Ford Instrument Co. Reliability Department. The investigation on diode reliability carried out by Autonetics was surprisingly paralleled at Ford Instrument Co. Similar microscopic examination of diodes was performed which agreed with Mr. Klass' disclosures and in addition revealed the following:

(a) In many cases of infant mortality diode failures, radial cracks from the junction or charring at the junction were predominant.

(b) Feeling is strong that the location of the whisker on the crystal face is also a factor in diode reliability, i.e. higher reliability with a centralized whisker versus one near the edge.

We are continuing investigation in this area particularly with regard to special burn-in processes in an effort to eliminate infant mortality.

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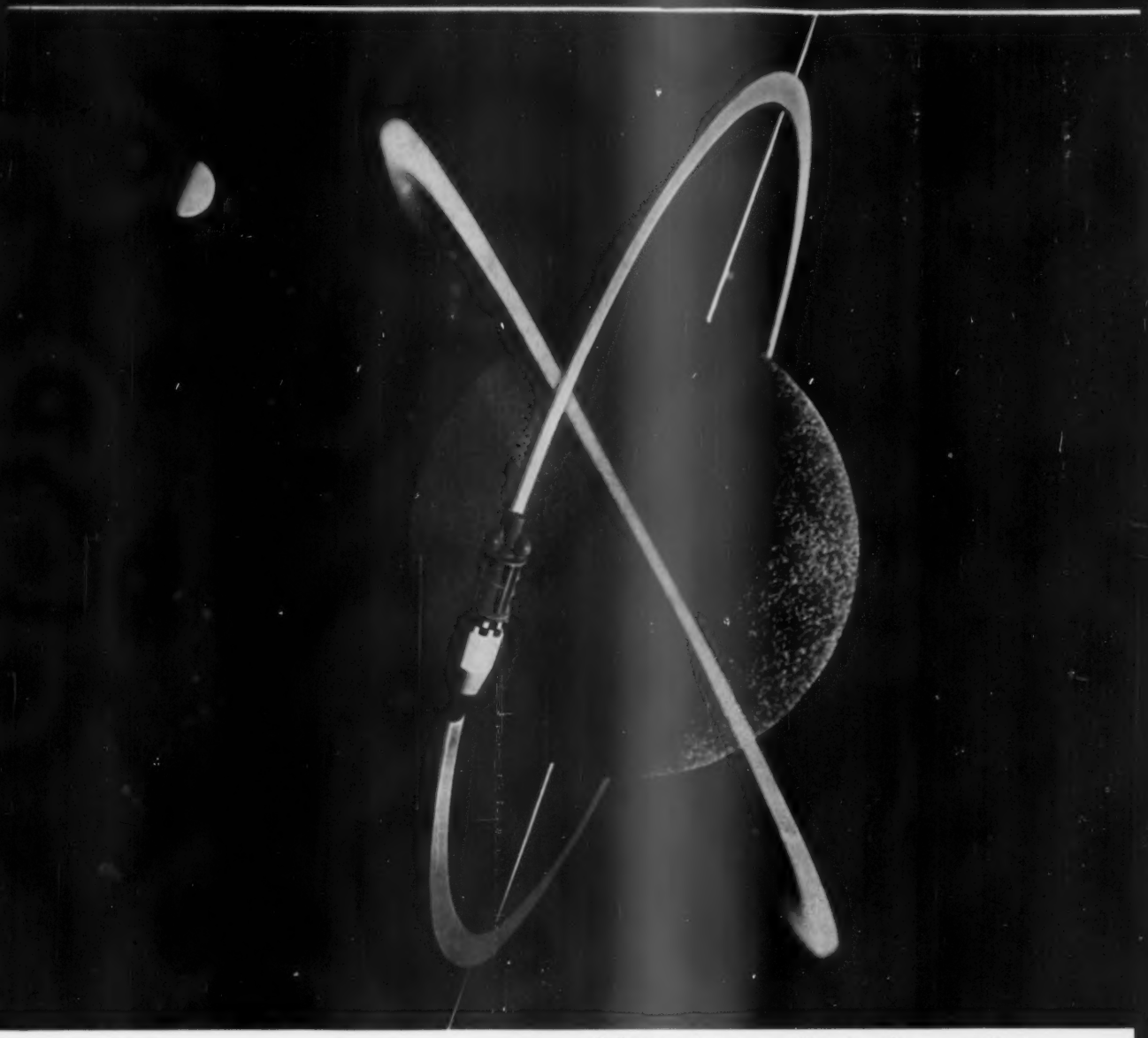

Bell-powered Agena satellites in orbit — symbolized.

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The Agena engine, designed with space in mind long before space became a household word, has fulfilled its every mission and has placed more tons of useful payload into orbit than any other power plant. Its operational reliability is backed by six years of development and 5,000 test firings.

This Bell engine now has re-start capability — the first in the nation. This means that its satellite can change orbit **in space** without the penalty of extra engines. Presently in production, this engine also is adaptable to new fuels and new assignments and, consequently, is programmed for important military and peaceful space ventures of the future.

Agena's engine is typical of the exciting projects in Bell's rocket propulsion center. It is part of the dynamic new approach of a company that's forging ahead in rocketry, avionics and space techniques. These skills serve all government agencies. Engineers and scientists anxious for a new kind of personal challenge can find it at Bell.

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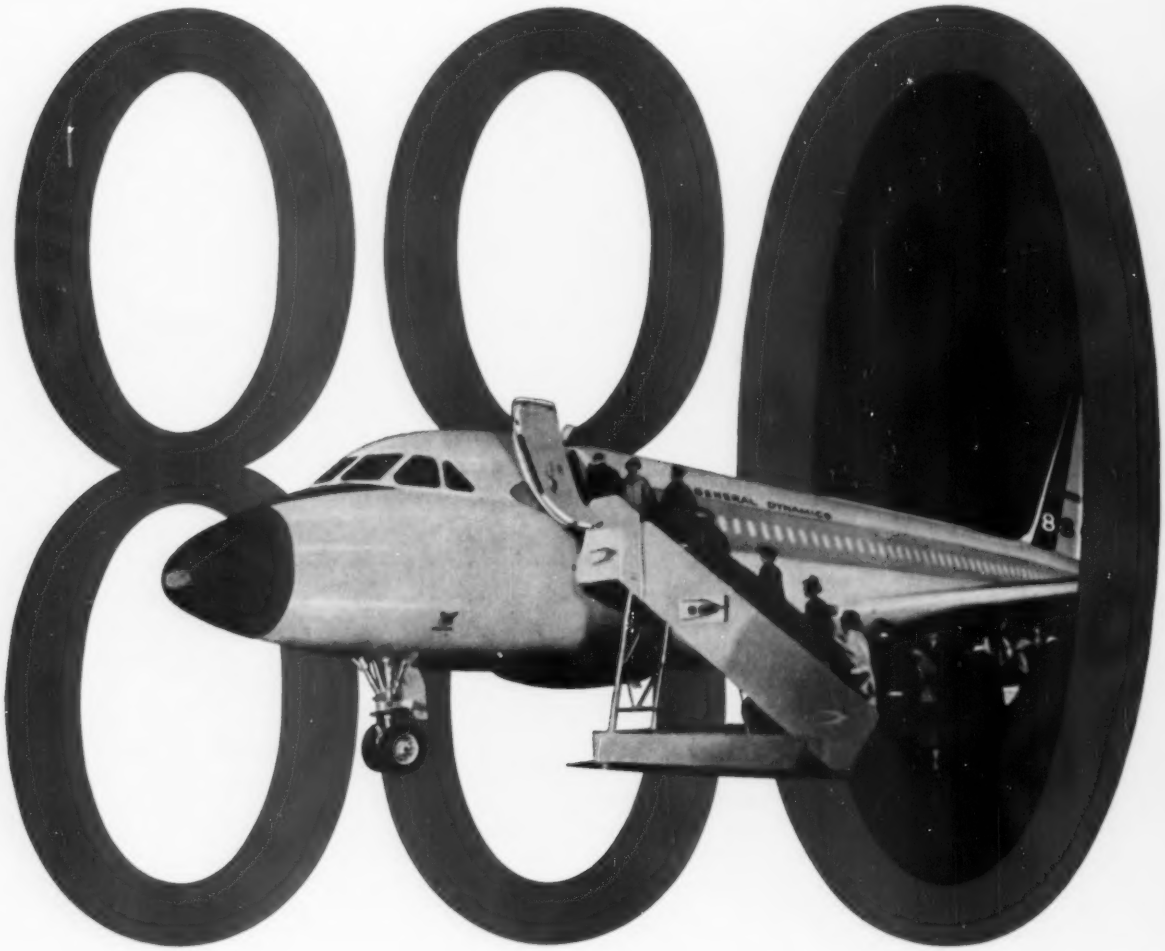

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